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DIAGNOSIS AND TREATMENT OF COLONIC DIVERTICULA

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THE rapidly growing literature on diverticulosis and diverticulitis indicates the increased attention being paid the subject in recent years. Although recognized and described as long ago as 1849 by Cruveilhier,[1] and by Virchow[2] in 1853, our real knowledge of this subject has developed since Graser[3] in 1898 described the formation of diverticula of the intestine and showed the great frequency with which diverticulosis occurred. Fischer[4] (1901) and Beer[5] (1904) made additional contributions. In 1906 appeared Moynihan's[6] important communication describing the mimicry of cancer by diverticulitis of the colon, and in 1907 Mayo, Wilson and Giffin[7] reported the first series of American cases (5) in which operation had been performed. The first really exhaustive work on colonic diverticula was that of W. H. Telling[8] in 1908. Then followed in rapid succession a series of publications by a great many authors, the outstanding contributors being W. J. Mayo, McGrath Morestin, Lejars and Menetrier, Lockhart-Mummery, Judd, Masson, Spriggs and Marxer.

The original publication of Graser showed how common was the development of diverticular formations in the large bowel, particularly in the sigmoid flexure. He emphasized the hyperplastic stenosing lesion known as peridiverticulitis and called attention to its mimicry of sigmoidal carcinoma.

Wilson[9] further described the secondary changes which followed inflammation of a diverticular sac. Colonic diverticula ordinarily are round or ovoid, having a sort of bottle or flask shape with a narrow neck connecting the sac with the lumen of the intestine. This explains the mechanism of retention of a portion of the fecal content with absorption of fluid and the formation of hard fecal lumps, sometimes as hard as shot. Inflammatory changes occur due to the mechanical irritation of the mass which is aways rich in pathogenic bacteria. The result is edema or induration with compression of the diverticular orifice, the deposit of connective tissue about the sacs producing the so-called peridiverticulitis, and sometimes stenosing tumor formation resembling ileocecal tuberculosis of the hyperplastic type. In other cases acute inflammation occurs with resulting abscess formation and its various sequella.

A great many of the diverticula, especially those in the upper alimentary tract, show no sign of inflammatory reaction and therefore are not really entitled to a descriptive word implying inflammation. Some years ago (1914) the writer proposed the term "diverticulosis" for this condition. It has also been proposed by other

authors including Spriggs and Marxer and de Quervain. However, even in the upper alimentary tract certain of these diverticula undergo active inflammatory changes in and about the sacs and merit the term "diverticulitis." Particularly in the colon, most of all in the sigmoid colon, we find the condition of "diverticulitis."

Various classifications have been proposed. Telling's classification, based on the pathological changes, divides the manifestations of colonic diverticula into mechanical and inflammatory, the mechanical including the formation of fecal concretions in the sacs, torsion of the diverticulum and lodgment of foreign bodies; the inflammatory changes including diverticulitis proper (acute, gangrenous, subacute, chronic and latent). The writer has employed the following as a practical clinical classification.

DIVERTICULOSIS

This group as above suggested includes those relatively frequent cases with few or numerous small hernial protrusions in the wall of the bowel, demonstrable on roentgen-ray examination, but not producing any symptoms referable to the diverticula. Spriggs and Marxer[10] found that ten per cent of their patients examined with the barium meal showed definite evidence of diverticulosis. We believe this figure is perhaps higher than will be found in average practice.

Jordan[11] suggests that colitis is the commonest cause underlying the development of diverticula, but it seems to us the case is more likely just the opposite, that the diverticula cause the colitis and many of these cases of diverticulosis really belong under the next heading. Of course, a vicious circle is soon established so that the two conditions contribute to each other.

DIVERTICULITIS

Enterospasm type, including that type of case in which the diverticula even though numerous are scattered and where the symptoms are apparently only those of enterospasm, kept up by continuous renewal of intestinal irritation from the retained contents of the diverticular sacs.

Hyperplastic type, in which the diverticula are situated fairly close together, especially in the region of the pelvic colon, where on account of their grouping the peridiverticular inflammatory reaction and the consequent production of connective tissue tends to produce a tumor with resulting organic obstruction.

Pseudoappendicitis type, where one or more of the diverticula, even where the saccules are not generally characterized by peridiverticular inflammation, undergoes an acute inflammatory process analogous to that occurring with acute appendicitis. We may include in this group inflammation of an epiploic tag. Telling called attention to the frequency with which the diverticula are covered over by the fatty epiploic appendages in such a way as to effectually hide the majority of the saccules from discovery by external examination of the bowel in the opened abdomen. An inflammatory process in one of these diverticula covered by a fatty intestinal appendage may result in an appendical epiploitis. The writer has operated on several cases where a single tag was thus involved, cure resulting in such cases from removal of the offending epiploic appendage. On section of the removed tag after operation, we have been able to demonstrate a hidden diverticulum in each case.

SYMPTOMS

Whether or not many cases fall under the heading of diverticulosis really depends on one's conception of what constitutes symptoms. Patients in whom we discover diverticulosis accidentally during roentgen-ray study almost invariably have complained of sufficient physical distress to bring them to consultation with a physician and he has found symptoms enough to warrant a roentgen examination of the colon, else the diverticula would not have been discovered. It is difficult to draw a

sharp line of differentiation between the cases of purely symptomless diverticulosis and the enterospasm type of diverticulitis.

The early symptoms of the group of cases of diverticulitis characterized by spasm of the colon are common to the early stage of many abdominal diseases: vague abdominal distress, slight intestinal upsets, discomfort in the abdomen particularly on the left side but occurring also on the right side. A well developed diverticulitis causes attacks of pain and tenderness over the entire colon, usually more marked in the left lower quadrant but also frequently combined with distress in the right lower quadrant. Bladder irritability is frequent and associated with tenderness over the middle of the lower abdomen. This abdominal tenderness is very commonly encountered and is often accompanied by muscular rigidity. Colics are not rare and when present tend to recur frequently. Moderate irregular fever may come on in attacks through a period of years. Leucocytosis may occur, with or without fever. Constipation is usual although occasionally alternating with diarrhea. Examination of the stools in this group seldom reveals the presence of blood, although in the cases of peridiverticulitis with tumor about one-fifth of the patients show blood in the intestinal excreta.

According to the predominance of certain symptoms, all cases may be classified as above described. In diverticulitis with enterospasm predominating, there is a notable absence of signs of tumor or obstruction, or an acute inflammatory development with suppuration leading to the necessity of urgent surgery. Abdominal distention, colicky pains especially across the abdomen, fever, hyperleucocytosis and other signs pointing to either the obstructive or the pseudoappendicitis type of lesion are absent, but there are the ordinary signs of chronic colitis.

In the pseudoappendicitis type, the patient, usually with a long history of a diverticulitis of the spastic type, suddenly develops acute symptoms demanding urgent attention. These symptoms should be distinguished from the true left-sided appendicitis which occurs only with nonrotation of the colon or in cases of true transposition of the viscera, but otherwise the complaints and signs are quite similar: hyperleucocytosis, fever, pain, tenderness usually over the left side, muscular rigidity, constipation occasionally alternating with diarrhea, localized peritonitis,—all suggesting the need of surgical intervention, at least for drainage of the infected area.

In the obstructive type, the symptoms are those of a long standing constipation with perhaps a history of several acute attacks simulating the so-called left-sided appendicitis but with progressively obstinate constipation, the development of colicky pains, notably across the transverse colon and in the right side of the abdomen, small, frequent stools or impulse to move the bowels without good results, and usually a palpable tumor. This tumor, thought to be due to bacterial inflammation of the intestinal wall, is generally described as sausage-shaped and exhibits intermittency as one of its importans characteristics. The appearance of a mast and its subsequent disappearance, with reappearance within a few days, is one of the most reliable signs of perisigmoiditis due to diverticulitis. This tumor may be felt either abdominally, rectally, or on a combined examination. There may occur a rare case of right-sided diverticulitis indistinguishable from appendicitis and perhaps even suggesting gall-bladder disease; here, as in other parts of the colon, the symptoms will depend somewhat on the exact situation of the inflamed diverticula.

In going about a diagnostic investigation in a case of suspected diverticulitis, it is important first to determine in which segment of the colon the lesion is probably located. The nature of the lesion will then engage our attention, whether inflammatory with suppuration and demanding surgical consideration, or obstructive due

to spasm and to the secondary formation of connective tissue.

The sigmoidoscopic examination offers some help and should always be made. It is occasionally possible by this means to visualize the orifice of one or more of the diverticula, and often one may draw conclusions regarding the rigidity or fixation of the pelvic colon. But a note of warning should be sounded regarding possible danger from the insertion of the sigmoidoscope into a segment of the colon which is the seat of diverticulitis. The writer has been called upon to operate in two cases where urgent acute symptoms followed within a few minutes an attempt at sigmoidoscopic instrumentation; in both cases rupture of a diverticulum had occurred.

Trauma of all kinds must be avoided in cases of suspected diverticulitis. From his series published in 1917, Telling[8] reports the production of acute diverticulitis from trauma as follows: straining at stool, two cases; administration of enema with high pressure, one; following heavy dose of castor oil, two cases; jolting in automodile, two; following a heavy meal, two; while lifting a weight, one; while jumping, one. Several cases occurred during abdominal operation. So not only must one avoid trauma in making a sigmoidoscopic study but even at operation the surgeon must be gentle in handling the diverticulum-bearing bowel.

Examination of the stool seldom gives decisive information. When a tumor or obstruction of the bowel is present, the stool investigation is of some help in differentiating between diverticulitis and carcinoma. The presence of blood or bloody mucus tends to strengthen the diagnosis of carcinoma but it may occur with diverticulitis. Judd and Pollock[12] observed blood in the stool in only 18 per cent of the cases of benign diverticulitis, while in those cases associated with carcinoma it was found in 47 per cent.

ROENTGEN-RAY EXAMINATION

The roentgen-ray study is really the only means of establishing a diagnosis of diverticulosis, and it is of decisive value in detecting diverticulitis. The first operated case, demonstrated roentgenologically before operation, was published by Abbe[13] in 1914, the roentgen-ray examination having been made by L. T. LeWald. The next publications on this subject were by the writer[14] and by the late R. D. Carman,[15] working independently. Both papers were published in February, 1915, the writer reporting thirteen cases, Carman reporting three cases of colonic diverticulitis. Carman thought it best to employ the opaque enema for demonstrating the diverticula, while the writer laid particular stress on the value of the roentgen-ray studies carried to the fourth or fifth day after the opaque meal examination, combined with the barium enema, as giving the maximum amount of information in these cases.

It is now recognized as necessary to employ both the opaque meal and the enema, and to take advantage of both screen and roentgenographic study. It is not enough simply to demonstrate residues in the diverticula, although this of course constitutes the best proof of the condition; we must also obtain all available data having a bearing on the diagnosis, the prognosis and the method of treatment. Some authors claim that in occasional cases the diverticula may defy the roentgenological demonstration, but by the technique which we shall describe it will be possible to show some sign of diverticulitis, even when the diverticula cannot be definitely identified.

The basic facts underlying the roentgenological interpretation of diverticula are as follows: The normal colon shows haustration. The haustral segments are regular and symmetrical except perhaps at the flexures. This segmentation is due to contraction of the muscle fibers and affects all layers of the bowel except the peritoneal coat, which marks the notches between the haustral sacs but does not enter into their formation. The haustra are normally present in a roentgenogram of the colon

whether following the meal or following the opaque injection. In certain states of colitis the haustral formation is inhibited so that the colonic outline is smooth; the more severe the colitis, the more conspicuous the absence of haustra in the roentgenogram. Following the passage of an opaque meal through the colon, one observes in cases of diverticulosis small rounded shadows, evidently residues of the opaque salt in the affected areas. These rounded shot-like residues may be scattered throughout the large bowel but are usually more numerous near the iliopelvic junction; they may be confined to that area. These rounded shadows usually occur in groups, but wherever they occur they maintain the same relation to each other and to the colon when visualized by its gas content or by the opaque enema.

The diverticula are best seen on the second or third day after the opaque meal when by careful screen study, especially during manipulation of the iliac and pelvic colon, one may detect their presence. These shadows sometimes appear shortly after the opaque meal reaches the affected segment but it most often happens that they are not recognized definitely until the second or third day, after most of the opaque material has been evacuated. It is at this moment especially illuminating to administer an opaque enema, carefully studying the rounded shadows in relation to the enema-filled colon. This study may be carried out fluoroscopically, though roentgenograms are especially graphic, and sometimes stereoroentgenograms furnish the most decisive and spectacular evidence. The diagnosis may be made frequently, if not almost always, by means of the enema alone but it is important that in such cases the enema should be retained for half an hour or longer. It usually occurs that in these cases the patient is able to expel the enema only from the rectum and lower pelvic colon, the remainder being retained. Screen or film studies half an hour to an hour later, or even ten or twelve hours later, will frequently demonstrate the filling of the diverticula in cases where they did not show immediately after the enema.

In the first case reported (Abbé), examined by LeWald, the diverticulum retained bismuth up to the tenth day. In one of the writer's cases of multiple diverticula reported in 1915, they were seen still filled on the sixteenth day. Much longer retention than this has been reported by several observers. As above stated, however, it is not sufficient merely to show up the diverticula; it is important to obtain information on several other points, particularly the question of peridiverticular induration, fistulae, obstruction, possible associated carcinoma and adhesions of the small bowel, determination of whether the case is advanced, and in early cases to decide whether or not there exist symptoms which correspond to the prediverticular state, described by Spriggs and Marxer,[10] and which will be discussed in later paragraphs of this paper.

If one definitely suspects a diverticulitis but finds no sign of the diverticula with the opaque meal, it may be helpful to give the maximum physiologic dose of belladonna or atropine during twenty-four to forty-eight hours. Then the usual preparation of the colon by cleansing enemas will considerably increase one's chance of demonstrating the diverticula by the opaque enema. The use of the antispasmodic will also aid in differentiating between an organic stricture and a spastic state, a differentiation very important to make but not always easily accomplished in diverticulitis.

The first notable step in the roentgenology of diverticulosis and of diverticulitis was the detection of the diverticula themselves (LeWald, Carman, Case). The second important advance in the roentgen study of this condition was initiated by George and Leonard[16] who in March, 1919, called attention to an appearance of the colon which they considered almost pathognomonic of chronic diverticulitis, even though the roentgenogram might

not show diverticula themselves. They said:

> Particularly along the descending colon and sigmoid one occasionally finds a peculiar serrated appearance. This may extend over several inches of gut and is associated with more or less narrowing of the lumen. These serrations are small, close together, and with a rather sharp point, presenting at times a sawtooth appearance . . . Repeated examinations given on different days show this appearance to be constant . . . The serrations do not change in size or shape. Furthermore, palpation under the fluoroscopic screen usually shows us that the intestine is more or less like a rigid tube . . . One infers that the serrated appearance is due to inflammatory thickening and induration of and about the intestinal wall, secondary to the presence of diverticula, the diverticula themselves not being visible.

This sounds very similar to the "prediverticular" state described by Spriggs and Marxer.[10] According to the latter, the normal segmentation of the bowel is absent, being replaced by a ragged outline of little convex irregularities, often seen along one side of the bowel only and sometimes confined to one haustrum only. In nearly all cases it is possible to detect at the same time both the prediverticular state and small diverticula in one part or another of the colon. A new fact brought out by Spriggs and Marxer is that this stage precedes the formation of the pouches and apparently is associated with some weakening of the submucosa and of the muscular layers. It is while the prediverticular state is in evidence that the minute herniae which subsequently form diverticula are pushed between the muscle fibers. Following this appearance of the prediverticular state there is often observed a stage of irritation causing a larger concertina-like appearance, sometimes giving to the colon shadow contours closely resembling the shadow of small intestine when slightly distended. This is followed by the fully developed diverticula of various sizes and shapes, many of them, even large ones, being made up of all the coats of the bowel as proven by the fact that they can be observed to contract.

The exact shape of the diverticular shadow obtained with the opaque meal or enema depends upon the diameter of the orifice of the diverticula. If the orifice is wide enough, the diverticulum does not retain its non-opaque contents and the opaque material has no difficulty in entering the whole of the diverticulum and filling it, giving a perfectly rounded or ovoid shadow. In a diverticulum with a narrow orifice, however, the opaque meal does not displace the former non-opaque content but fills only the proximal portion of the pouch lying next to the lumen of the bowel, thus giving rise to a very characteristic crescentic opaque shadow. Occasionally one sees long finger-like diverticula closely resembling the vermiform appendix, sometimes shaped like an Indian club, extending between the folds of the mesocolon. It is quite possible that in acute diverticulitis in certain areas, the orifices of the diverticula may be completely obstructed so that it may be impossible to fill them by the enema or by the opaque meal, but elsewhere in the same colon it should always be possible to demonstrate the diverticula or diverticulitis.

As the third important step in the development of the roentgen-ray study of diverticula, the writer offers still a new observation. At a certain stage in each opaque meal examination, toward the end of gastric clearance, one sees the small intestinal loops well visualized. Naturally the ileac coils occupy the true pelvis, the jejunal coils lying higher in the abdomen, and toward the left the terminal coil of ileum is noted reaching up out of the true pelvis toward the ileocecal junction on the right side. When there exist fibroids, ovarian cysts and other pelvic tumors, pathological and physiological, the small intestine is lifted out of the true pelvis higher up into the abdomen. We have observed for years a similar roentgen-ray appearance in certain cases of divertic-

ulitis of the sigmoid; several hours before this part of the colon has been visualized, one notes a displacement of the small intestinal coils upward and toward the right. The normal undistended colon is easily compressible; when distended by gas, the gas is clearly observable, or, if filled by non-opaque fecal matter, this can be determined by a cleansing enema. But with these possibilities ruled out the amount of displacement is such that one can suspect a fat-laden sigmoid covered with swollen and edematous or inflamed epiploic appendages, the total forming a mass of considerable proportions. The idea that this finding (displacement of the small intestine upward and toward the right away from the left iliac fossa) may be due to the diverticula-laden sigmoid with marked peridiverticular manifestations, is strengthened in some cases by carefully noting the gas content of the area of sigmoid under suspicion, as in Figure 1. Here one sees clearly the gas content of the sigmoid, a row of small gas collections nowhere exceeding ½ in. in diameter (indicated by arrows), and yet the vacant space in the left iliac region due to the displacement of the small intestine is at least 3 in. in diameter. It is manifest that the difference between the 3 in. of vacant space and the ½ in. of colonic lumen represents the mass made up of the fat-laden, enlarged epiploic appendages attached to the already thickened walls of the colon.

For the meal we prefer barium sulphate in buttermilk (formerly we used bismuth subcarbonate). This has been our standard opaque meal for twenty years. For the opaque enema we employ barium sulphate in warm buttermilk or in a gum suspension.*

Fig. 1. Roentgenogram made four and one-half hours after an opaque meal, showing displacement of small intestine away from inguinal region to a much greater extent than usual—a new sign of sigmoidal diverticulitis. Case 1. Illustration retouched slightly to emphasize gas areas.

Exquisite pains should be taken with the roentgenographic technique in order to obtain every bit of fine detail. An accurate study of diverticulitis cannot be made except with first class roentgenograms.

When one detects in the pelvic colon a filling-defect with a localized narrowing of the lumen of the bowel, carcinoma rather than diverticulitis is naturally suggested, but it must be remembered that diverticulitis may coexist with carcinoma and that either condition may precede the other. At any rate, a coexistence of carcinoma with diverticulitis occurred in about 15 per cent of the Mayo Clinic cases. Max Ballin[17] believes that carcinoma arising in a diverticulum has certain characteristics in that it does not often grow toward or encroach upon the lumen of the bowel, and, therefore, a filling defect may not be apparent in the roentgenogram. Telling thinks it likely that carcinoma can cause diverticula and he is certain that diverticula may be followed by carcinoma formation; this leads him to state the following very important axiom:

* The writer's formula is as follows: To 2½ dr. of gum tragacanth, add about 1 oz. of alcohol. Shake well. Add 20 oz. of warm water and shake. Add 3 oz. of barium sulphate, then 20 oz. of water, shaking well each time. This mixture should be made up fresh shortly before using.

Ordinary buttermilk or mineral oil (Paralax, Petrolagar, etc.), warmed to the temperature of 100°F., serves very well as a vehicle for the suspension of the barium for enema purposes. This latter preparation has the advantage of being quickly made ready.

No case of supposed carcinoma of the lower bowel must in future be regarded as inoperable either before or at laparotomy unless diverticulitis has been remembered, fully considered and systematically investigated.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis involves especially sigmoiditis, hyperplastic tuberculosis, carcinoma, actinomycosis, syphilis, left-sided (true, transposed) appendicitis, and certain pelvic conditions. Sigmoiditis is an older disease which may have a special dysenteric or local bacterial origin. It is probable that most of the reported cases of sigmoiditis were cases of diverticulitis. Some cases of sigmoiditis occur at earlier ages; the greater portion of them end in spontaneous recovery. There is more frequently an involvement of the mucosa. Syphilis is rare in the sigmoid; anyhow there are other evidences of lues which can be brought out in any suspected case. Actinomycosis usually occurs in the cecum, and the clinical and pathological developments are very much different than in diverticulitis. Hyperplastic tuberculosis is rare in the sigmoid although it does occur. Mailer[18] reports two cases in which there was operatively proved a coexistence of diverticulitis and tuberculosis of the sigmoid. Pelvic lesions are usually left sided, but the bimanual examination and the history usually permit a differentiation. In making studies of gynecological cases it is well always to keep in mind a possible diverticular lesion. Differentiation must also be made between diverticulitis and fecal impaction, encysted foreign bodies, chronic abscess, fistula and vesical tumor.

The most important lesion to be differentiated is sigmoidal carcinoma. In carcinoma of the pelvic colon loss of flesh occurs early. The painful symptoms do not develop until late. The formation of a tumor usually precedes the development of pain and tenderness. The sigmoidoscope is usually of little use in differentiation. Telling says the diverticular orifices seldom or never ooze pus. Indeed, it is difficult to understand how the sigmoidoscope can give much aid when we realize how hard it is to locate the diverticular orifices with the removed segment of bowel in the hand. When the sigmoidoscopic examination is negative the evidence is somewhat against carcinoma and in favor of diverticulitis.

TREATMENT

Prophylaxis. Careful education of the colon (establishment of the habit of regular spontaneous evacuation) and the practice of hygienic measures tending to improve the intestinal flora are prophylactic means of undoubted value in combatting the development of diverticula and the mutation from a diverticulosis to a diverticulitis. Increased intracolonic pressure unquestionably plays an important part in the deve opment of sacculations and, when combined with increased sepsis of the contents of the colon, tends to produce the condition known as diverticulitis. An increased intracolonic pressure is encouraged by an attempt to resist the desire to empty the bowels, by straining at stool, and by acquiring the enema habit, especially the use of large enemas which produce markedly increased intracolonic pressure.

Diverticulosis is a common condition and calls for no other treatment than prophylaxis by ordinary attention to colon hygiene.

As for diverticulitis, it is important for surgeons to recognize that there is a *medical treatment*. While the disease is still confined to the colonic wall, it is possible to keep most patients in good health if they will adhere to the hygienic scheme below outlined. When the secondary inflammatory manifestations have occurred, then operation should be seriously considered, but even when a tender inflammatory mass can be palpated the lesion can often be made to subside by non-surgical management. However, such a case should be kept under close scrutiny until the danger of perforation or of abscess formation has been safely passed.

The hygienic scheme alluded to above

means careful attention to the general habits of the patient, avoidance of overwork, regularity in meals, discontinuance of smoking, the use of an abundance of paraffin so that the patient really leads a "paraffin life." A simple lactovegetarian diet with careful attention to regulation of the colon is a splendid prophylactic. The diet should be supplemented by plenty of lactose, or lactodextrine. Irrigation of the bowel should be practiced daily with saline solution, or, better yet, malt sugar or lactodextrine enemas at low pressure. Abdominal massage may be dangerous in these cases, especially when given over the diverticulum-bearing area of the bowel. Violent or irritating treatment may quite possibly reactivate a quiescent lesion, resulting in pain and even danger to the patient.

If the condition is acute, malt sugar or glucose enemas should be employed under low pressure; in some cases, warm olive oil in the quantity of 4 or 5 ounces may be preferable. It is important to abandon all purgatives for they are not only irritating but they may be even dangerous. On the other hand, antispasmodics are distinctly indicated, especially belladonna or atropine. In most instances of acute diverticulitis, the symptoms may be allayed within a few days by such treatment and even a tumor may be made to disappear.

Warnings have been voiced against the use of fruits containing small seeds, such as figs, currants, strawberries, raspberries and gooseberries. These warnings do not apply to foods producing bulky residues. Such foods as graham, whole wheat or bran breads, oat meal porridge and vegetables are probably better, provided the bowels are moved at least twice daily. Paraffin oil should be given in as large quantity as the patient can tolerate. Later on the paraffin may be diminished.

The writer in his original paper on the subject of diverticula advised daily doses of bismuth subcarbonate as a prophylactic. Moynihan mentions that very large doses of bismuth may be usefully administered from time to time in the hope of subduing infection.

Surgical Treatment. Operative interference should be elected as a means of treatment only in severe cases. A wide range of opinion exists regarding the preferable mode of surgical treatment. Some authors believe that the inflammatory sequelae of diverticulitis may be relieved medically. Others are of the opinion that the treatment should be conservative, but that when abscess does occur it should be treated as an abscess anywhere else in the abdominal cavity. Erdman believes that the acute type of diverticulitis demands drainage or removal as does a diseased appendix. Rogers states that he recognizes the possibilities of an acutely inflamed diverticulum and that his judgment would lead him to operate as soon as the diagnosis was sufficiently certain to justify surgical intervention.

In cases of diverticulitis (which refers to diverticula giving rise to symptoms), because of the potentiality for trouble, it should be a principle of surgery to remove the diverticulum-bearing gut when practicable. With obstruction relief is required and resection is the operation of choice, but if this is not possible one may have to do a colostomy or an exclusion operation. In the latter event it may be possible to do resection later, depending on the age and the condition of the patient. Sometimes a Mikulicz multiple-stage operation is applicable when the adhesions of the affected segment of the sigmoid can be freed. However, in practice it is seldom possible to resect the mass because of the dense adhesions surrounding it. Indeed it is questionable whether it is wise to even attempt to separate these adhesions unless a careful survey makes it quite evident that a resection will be possible. The adhesions are not only very dense but they are septic foci which if disturbed may result in acute peritonitis. In the majority of cases it is not wise to attempt a resection of the affected segment. In the average

case a colostomy above the obstruction or an exclusion operation is the procedure of choice. Even when there exists a perforation of the bladder, a preliminary colostomy is preferable; the resection may be done later. As above remarked, in cases associated with marked tumor formation these inflammatory masses may disappear in a short time when a colostomy is made proximal to the tumor. This has occurred even in cases with multiple tumors. If an external fistula is made, it must be kept open a sufficiently long time or the tumor will recur. The writer much prefers to make an internal fistula, short-circuiting the tumor, rather than a colostomy when the tumor is irremovable.

Mummery[19] suggests another surgical possibility, namely, to free the damaged portion of the bowel as much as possible and then wrap it with omentum. It may be possible to remove the more prominent diverticula and perhaps to carefully separate a number of adhesions. This wrapping with omentum is intended to prevent the inflamed sigmoid from again becoming adherent directly to the bladder or to the small intestine. This procedure may occasionally save patients from a permanent colostomy but the operative mortality is fairly high for infection is a serious consideration. For that reason, here, even more than with carcinoma of the colon, a preliminary temporary colostomy will tend to reduce the mortality.

Gerzowitsch[20] in 1925 reviewed 316 cases of operation for diverticula of the large bowel. In 85 cases of operation done for abscess and peritonitis, 50 per cent of cures resulted. In 44 operations for intestinal stenosis, 21 were treated by resection with one death, seven by colostomy with one death, five by enterostomy with two deaths and eleven by some operative procedure not specified. In five cases of colitis of very severe type, especially with hemorrhage, operation resulted in five cures (type of surgical procedure not specified). Finally in a last group of 182 cases where the type of operative procedure was not clear, the immediate result was published in 51, resulting in 44 cures, seven deaths. In 131 cases the reporter failed to give an account of the operative details. Selecting from the 316 cases the ones giving sufficient details for tabulation, it is possible to make the following graphic presentation:

	Cases	Recoveries	Deaths	Results not specified
Resections.....	104	54	7	43
Colostomies.....	8	7	1	0
Enteroanastomosis..	6	2	2	2
	118	63	10	45

According to the known results in the resection cases (54 recoveries and 7 deaths), the percentage of recovery was 87. Only a few late results were given in the above series; in ten cases the patients were found to be perfectly well from four to eleven years after operation.

Persistent attacks of pain and tenderness in spite of careful medical prophylaxis, signs of threatened obstruction, a palpable tumor of the colon, frequent and painful urination with attacks of pain in the left iliac region and symptoms of an abscess or peritonitis, are definite indications for surgical treatment of diverticula. Perforation and abscess or localized peritonitis demand prompt transfer to the surgical service. Simple drainage will often suffice in such a case without ever forgetting that the cause of the trouble is not modified by such symptomatic management. Persistent tumefaction or obstruction demands exploration or resection because of the danger of malignancy, though sometimes a colostomy will prove to be the only treatment feasible.

A few typical cases will be reported illustrating the various principles of diagnosis and treatment above set forth.

CASE REPORTS

Case 1. Cecal Diverticulitis; Resection of Diverticulum.

Fig. 2. Diverticulum of the cecum (at arrows) twenty-six hours after the opaque meal. Case I.

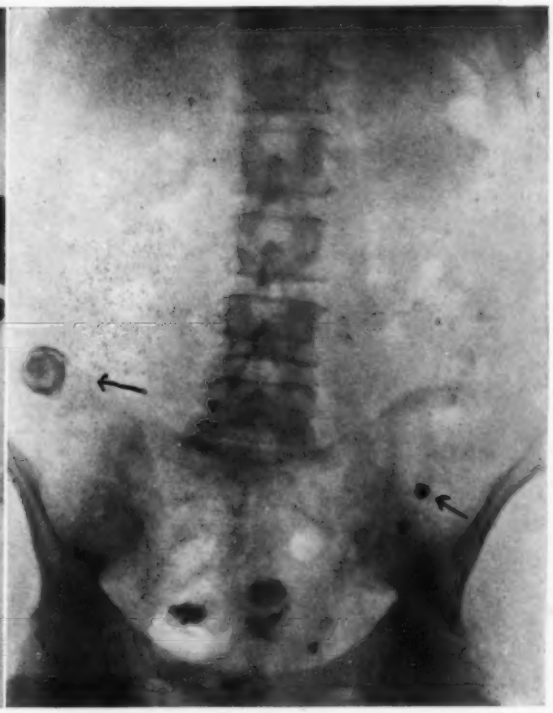

Fig. 3. Diverticulum of cecum, fifty hours p. c. Case II.

White female, aged forty-seven, admitted December 27, 1923, complaining principally of a chronic lower abdominal pain which had persisted in spite of operation for removal of the gall bladder and the appendix four months ago. The pain came whenever she ate, appearing a few hours after the meal, described as a terrible burning pain across the lower abdomen, preventing sleep. For the previous two weeks the pain had been much more severe, mostly localized about the cecum but radiating toward the middle of the lower abdomen. In addition to some minor troubles, the roentgen-ray study showed a condition of colonic diverticulosis, with one especially large, poorly drained diverticulum of the cecum (Figs. 2 and 3). The patient returned to her home for operation by the same surgeon who had previously removed the appendix. He operated again six months after his first operation, removing a diverticulum measuring 2.5 by 3.5 cm., containing a concretion almost as hard as rock entirely filling the sac. The symptoms have not recurred.

Case II. Diverticulosis of Transverse Colon; Prophylactic Diverticulectomy; Cholecystectomy; Division of Constricting Pericolic Membranes of Ascending Colon.

White female, aged fifty-seven, admitted December 14, 1922, complaining chiefly of pain and burning between the shoulders and especially pain in the top of the right shoulder, acid eructations and sometimes a burning pain in the back and hip on the left side. Several years before, appendectomy was done for chronic appendicitis. Several gastrointestinal upsets had occurred within the last three years for which she was under the care of a stomach specialist. Recently she had noted an increase of abdominal pain after dietetic indiscretions. Constipation had existed for years, for relief of which she had taken much laxative medication, chiefly calomel. There were inflamed and bleeding hemorrhoids.

Examination resulted in the following findings: normal gastric report, clinically, chemically and roentgenologically; chronic cholecystitis, probably non-calculous; cecal dilatation with stasis in proximal colon; several small diverticula of transverse colon (probably intramesocolic); hemorrhoids; congenital multiple exostoses.

On December 28, 1922, the patient submitted to operation for removal of the gall bladder because of chronic cholecystitis and marked pericholecystitis without stone, division of a parietocolic band along the ascending colon,

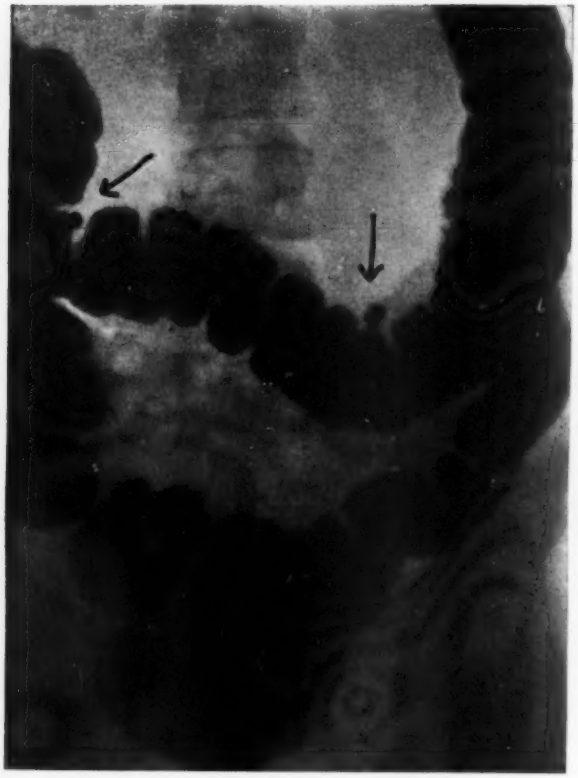

Fig. 4. Enema-filled colon showing two intramesocolic diverticula (at arrows).

Fig. 5. Same case as Figure 4, shown after evacuation of most of opaque clysma. Diverticula more clearly shown. Case II.

Fig. 6. Sketch made at operating table illustrating the location of the larger diverticulum of Figures 4 and 5. Case III.

and prophylactic resection and inversion of the stump of the larger of the two diverticula found, as shown in the roentgenogram (Figs. 4 and 5). There were no adhesions or other sign of inflammatory reaction about the diverticula but since the larger one lying to the left of the middle of the transverse colon contained a hard stercolith which was expressed with some difficulty, its removal was deemed a wise prophylactic procedure. The diverticulum lay between the folds of the transverse mesocolon, measuring about 2 cm. in diameter, with an orifice half that size. Several small blood vessels passed along the peritoneal covering of the divreticulum but two conspicuously larger vessels passed one on either side of the sac into the colon, as illustrated in Figure 6. The patient made a normal recovery and was able to report satisfactory improvement a year later.

There was no reason to anticipate any improvement attributable to the diverticulosis; the operation was done as a purely prophylactic measure, made possible by the necessity of operative interference for cholecystitis and cecal stasis.

Case III. Large Diverticula Limited to Transverse Colon; Diverticulitis; Resection and Immediate Anastomosis.

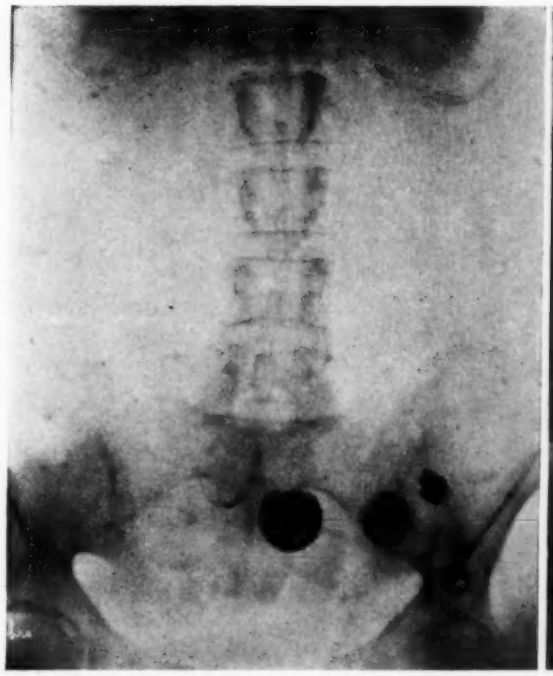

Fig. 7. Large antimesocolic diverticula of transverse colon, shown fifty hours after opaque meal, the remainder of barium having been evacuated. See Figures 8 and 9.

Fig. 8. The diverticula of the transverse colon shown in Figure 7, seen in relation to the enema-filled colon. See Figure 9. Case III.

Fig. 9. Photograph made during operation on transverse colon diverticula of Case III. See Figures 7 and 8.

White female, aged forty-eight, admitted August 13, 1923. Family history negative for any lesions simulating diverticulitis. The patient was never very strong but she had suffered from considerable diarrhea at times, coming in attacks of short duration. For the previous two and a half years the patient had complained of severe headaches, periods of hyperacidity, symptoms suggestive of cystitis, constipation interrupted occasionally by short attacks of diarrhea, spells of abdominal pain with distention, so that abdomen became hard and tense. No mucus or blood noted in the stools. Increasing arterial tension during the last two years (on admission 135/90). Abdominal examination revealed a full, tense cecum

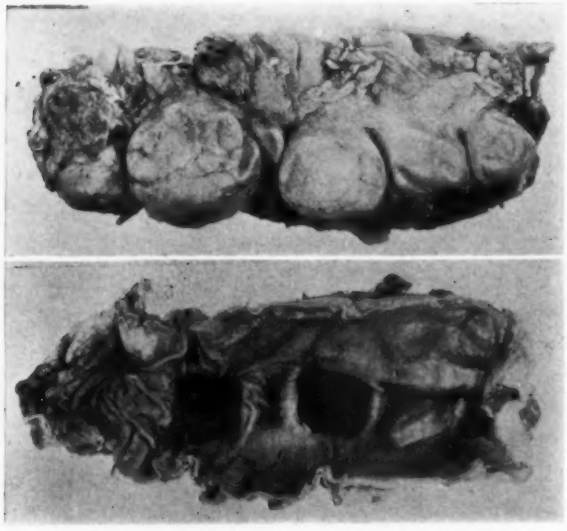

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Fig. 10. (Case III) Photograph of hardened specimen of transverse colon diverticula, unopened. See Figures 8 and 9.

Fig. 11. (Case III) Operative specimen of transverse colon diverticula, hardened specimen, opened.

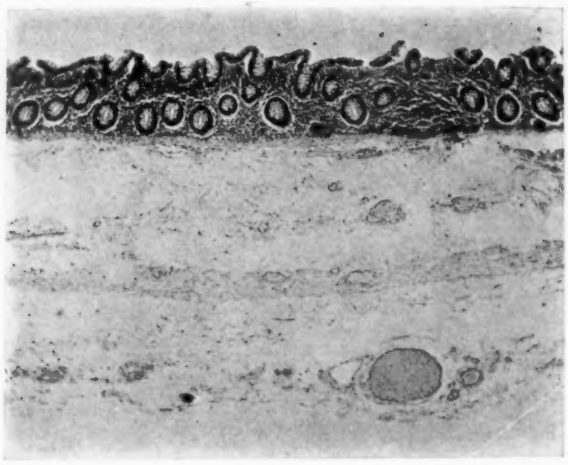

Fig. 12. Photomicrograph of one of the diverticula of Case III.

with some tenderness on palpation over the midabdomen. Blood picture normal; leucocytes 7,500 to 8,700. Because of certain food relief of hyperacidity and previous suggestions from examining physicians, the patient was put through a barium meal study with results shown in Figures 7 and 8. Figure 7 shows four large diverticula of the transverse colon, the larger of which retained barium content in much greater density than the others. The diverticula measured, in shadow, from 2.5 to 4.0 cm. in diameter, and are shown here fifty hours after the opaque meal, persisting in spite of cleansing enemas given in preparation for the opaque injection, illustrated in Figure 8. There was a normal duodenal bulb. Subsequent observations showed the diverticula still filled with barium on the fourteenth day.

Operation September 3, 1923. Under nitrous oxide-oxygen anesthesia, the transverse colon was exposed and the diverticula easily located by palpation and inspection on the antimesenteric border of the colon midway between the attachments of the mesocolon and the great omentum (Fig. 9). About 20 cm. of the transverse colon containing the diverticula was resected, carefully preserving the great omentum. Continuity of the bowel was at once restored by end-to-end anastomosis, and some omentum wrapped around the junction.

Immediately after terminating the operation, the writer made the following observations: The proximal pouch joined the bowel by an opening, measuring less than 1 cm. in diameter, surrounded by a definite hard ring; in none of the other sacculations was this ring to be felt. The largest pouch measured 4.5 cm. in diameter and its orifice 2.0 cm. The two proximal pouches were filled with hard material, expressed with great difficulty. The content of the second, the largest, pouch consisted of very hard, dry material, including barium given fifteen days before the operation, carmine in laminated streaks, bran, and dried out fecal matter. The external appearance of this diverticulum in the fresh specimen suggested the aspect of a Meckel's diverticulum which had undergone repeated inflammatory crises.

Pathological report (by A. S. Warthin): The hardened section of colon removed measured 18 cm. in length (Fig. 10). On its free margin it presents a series of five* saccular dilatations and one smaller, imperfectly developed, shallow diverticulum between the second and fourth from the proximal end. The largest sac measured 3.5 cm. in diameter, the smallest 1.5 cm. The saccular diverticula are almost spheric. The peritoneum over these appears normal. There are no local adhesions, and no evidence of local peritonitis.

Viewed from the lumen of the intestine

* Roentgen-ray study as well as inspection at the operation and immediately after clearly showed only four large sacculations which had any tendency to retain their contents. The pathologist describes six diverticula in the hardened specimen. Comparison of the roentgenograms with the photographs suggests that there is a definite relation between enlarging haustra and diverticula.

(Fig. 11), these diverticula show mouths varying in diameter from 6 mm. to 2 cm. The uppermost and the lowermost have narrower constricted openings. The six diverticula lie close together. The lower three are separated by partitions only 4 mm. in thickness. The largest one, next to the uppermost, is separated from its neighbors by a broader area of mucosa, about 1.5 cm. These saccular diverticula are all lined by mucosa containing lymph follicles. They appear to the naked eye to consist of mucosa and serosa only; the muscle coats appear to be lacking. Between the second and the third diverticula there is an imperfectly developed pouch about 4 mm. deep. The wall of this is less translucent and contains unstriped muscle.

There are no gross pathological changes apparent in the walls of the sacs. The constricted mouth of the uppermost one shows slight radial constriction of the mucosa about the mouth but no other pathological appearance. Transverse section of the uppermost one was taken for microscopical study (Fig. 12).

On microscopic section the wall of the saccular dilatation is seen to consist of mucosa, muscularis mucosa, submucosa and muscle coats, the external muscle coat being relatively poorly developed but in patches showing some hypertrophy and new formation of unstriped muscle fibers. There is a gradual decrease in both coats toward the center of the sac but the disappearance is particularly marked in the inner coat, both coats becoming reduced to very narrow bands containing only a few fibers. The smaller blood vessels show thickened walls in this area of greatest muscular atrophy and there are small areas of inflammatory infiltration scattered through the subserosa. These infiltrations are most marked at the borders of the saccular dilatation at the point where the atrophy of the muscle coats begins to be most marked. The mucosa of the colon shows everywhere a chronic catarrh, moderate atrophy, numerous eosinophiles in the interstitial tissue and numerous pigmented phagocytes. The eosinophiles are eosinophilic plasma cells, Russell Plimmer bodies.

The lymph nodes are all atrophic. The mucosa over the saccular dilatation is well preserved, showing only a little atrophy. These saccular dilatations are of the acquired type, a gradual stretching of the wall with atrophy of the muscularis. The partitions between the openings into the diverticula are formed by the semilunar folds. The diverticula, therefore, represent dilatations of the intestinal wall between these folds.

The patient reported one and five years later, recording a gain in weight of ten pounds more than ever before in her life, freedom from the abdominal attacks of pain and distention, absence of digestive complaints, and general renewal of health.

Case iv. Diverticulitis of Transverse Colon and of Sigmoid, with Multiple Tumor; Cecosigmoidostomy.

White male, aged seventy-five, admitted May 28, 1925, complaining of pain and aching in the upper abdomen. A previous examination at the Battle Creek Sanitarium in 1917 resulted in a diagnosis of multiple diverticula of the colon (Fig. 13), the sacculations being distributed pretty much throughout the colon but rather more numerous in the upper part of the pelvic loop. There were also diverticula in the duodenum. At that time he was accompanied by his brother who proved to have a similar condition of extensive diverticulosis. In December of the following year a cholecystectomy was done for an acute gangrenous cholecystitis and it was hoped that this would relieve the upper abdominal pain which had disturbed him for some years. When the upper abdominal distress continued, the question arose as to how much of it might be due to the adhesions which surely followed such a gall-bladder condition. There was a constant feeling of tenderness and pressure in the left lower as well as across the upper abdomen, with frequent bowel movements and much gas distention. Repeated stool examination showed no more than an occasional trace of blood, and this was attributed to the hemorrhoids reported by the proctologist. About May 1, 1925, the patient's symptoms became urgent. One morning about 2 o'clock, he was awakened by pain in the upper abdomen; since then he had been having more or less pain across the epigastrium apparently not related to meals. No regularity as to time of appearance or duration. Paregoric was employed for relief. Bowels badly constipated. Unable to take enemas because of pain; could take only a small injection, which he had to expel immediately and with force.

Examination showed a definite resistance in the epigastrium and under the left costal margin which, when palpated under the fluor-

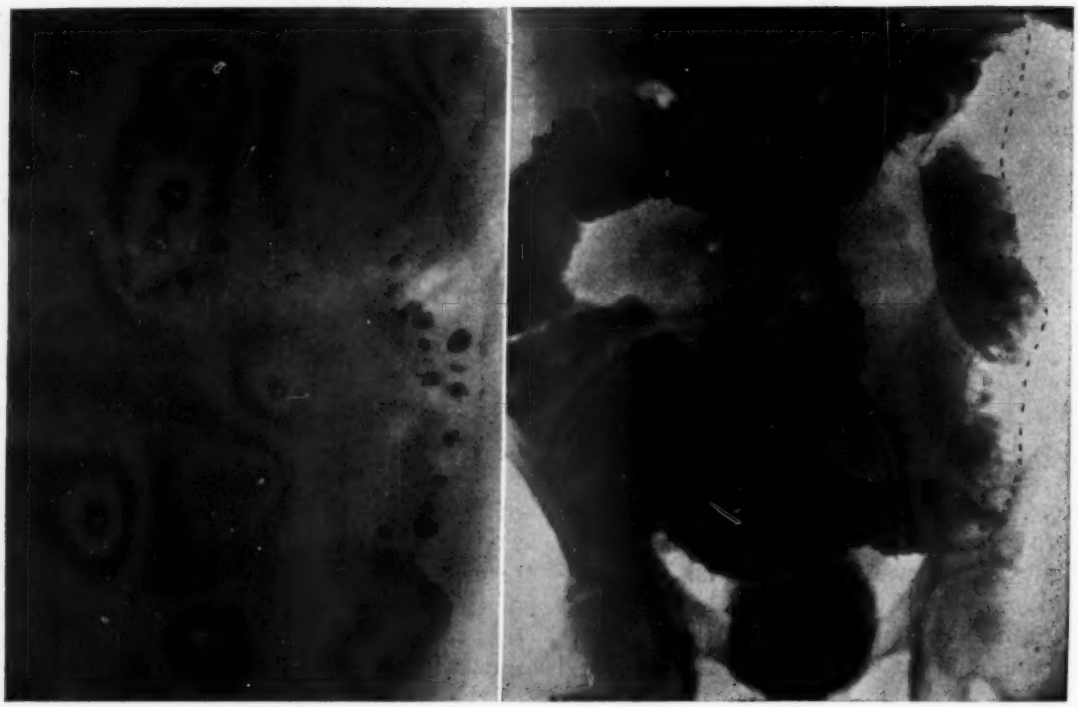

Fig. 13. (Case IV) Roentgenogram made eight years before admission. Fifty hours p. c. Multiple diverticula of entire colon, especially marked in transverse descending colon and sigmoid.

Fig. 14. Same case as Figure 13 (Case IV), colon filled by opaque enema after recovery from operation for cecosigmoidostomy. Note transverse colon of normal caliber, filling defect and palpable tumor having disappeared.

oscopic screen, coincided definitely with the transverse colon visualized by the opaque enema. On account of the acuteness of the symptoms and the elevated white cell count (12,900), the patient was given medical attention as outlined in the body of this paper, but in spite of all effort the symptoms of obstruction grew steadily worse and a definite left subcostal tumor became palpable. The question of carcinoma arose. Because of the patient's age, long history, and the narrow zone of filling-defect in the colon shadow, although only a trace of blood was noted in the stool, carcinoma was definitely suspected and some form of exclusion operation recommended.

Operation June 13, 1925, under lumbar anesthesia. The transverse colon was held high by adhesions of the omentum in the gallbladder region which made it impossible to examine the liver. The descending colon and the upper half of the sigmoid was a mass of diverticula with definite tumefaction. A few scattered sacculations were made out in the cecum and in the lower half of the sigmoid, but there was no induration in this part of the bowel. The left half of the transverse colon was the seat of a large, very hard mass which seemed definitely malignant rather than inflammatory. It was not adherent to the abdominal wall and it moved up and down on respiration. There were numerous adhesions of the cecum but none of the small bowel. The cecum and the lower half of the sigmoid were sufficiently freed of adhesions to be approximated, after which a cecosigmoidostomy was done with a Jaboulay button. The convalescent period was less stormy than had been anticipated. The button passed on the forty-seventh day. The tumor in the left hypochondrium gradually diminished in size and finally disappeared. Examination of the colon by opaque enema on the fiftieth day demonstrated normal caliber of the transverse colon (Fig. 14) where previously a definite filling-defect was plainly to be seen. The patient, a physician, resumed his practice. Nearly three years later he is reported as continuing in good health, free from any symptoms of diverticulitis.

A possible hereditary transmission of a tendency to diverticula formation has been suggested by MacKoy[21] who reported eight members of a family in three genera-

tions who suffered from a chronic intestinal trouble that presented similar clinical pictures in all cases. The brother of the case just described (Case IV) is another example of an apparent familial tendency.

Case V. Epiploitis (Acute Diverticulitis?) of the Sigmoid.

White woman, aged forty-nine, was seen as an emergency April 21, 1920, suffering with pain in the left inguinal region; she was decidedly nauseated and vomited frequently. She had a sudden attack of severe pain about 2:30 A.M. of the 20th, requiring hypodermics for relief. Temperature, not abnormal; pulse, 84. No abdominal distention. Some carefully administered warm enemas were evacuated without difficulty. About 8:00 o'clock there was a recurrence of the pain and the vomiting, tenderness being most marked along the descending colon and sigmoid. Blood count: hemoglobin 83 per cent; red cells, 3,700,000; white cells, 22,500; polymorphonuclears predominating. The following morning the attending physician ordered a roentgen-ray study of the urinary tract which showed no abnormalities. Roentgen-ray study of the colon by enema showed adhesions and marked spasticity of the pelvic loop but no definite diverticula. Carcinoma was suspected, with an acute obstruction supervening.

Immediate operation was performed. The proximal colon and the small intestine were tensely distended but no mass could be palpated anywhere in the colon. In the pelvic loop there was found a mass lying between the folds of the mesocolon at a point about 8 in. above the peritoneal reflexion and some adhesions of the pelvic loop to the left tube and ovary. One of the epiploic appendages which was inflamed was removed as one would remove an appendix. The appendix vermiformis was examined and found free from any acute inflammation although it shared in the general turgescence of the entire colon. In view of the high white cell count a tube drain was placed in the left iliac fossa. The patient made an uneventful recovery leaving the hospital for home on the seventeenth day.

Pathological report (by A. S. Warthin): Congested, inflamed epiploic appendage. No trace of diverticulum in the specimen examined.

In two other cases of this type which have come to operation in our service,

Fig. 15. (Case VI) Colonic diverticula especially numerous in iliac and pelvic colon, with signs of peridiverticulitis.

diverticula have been identified in the epiploic appendage; but in this case no diverticulum was found. We believe this type of epiploitis has a diverticular origin. Further possible doubt on the diverticular origin of this case is cast by the fact that the roentgen ray failed to demonstrate diverticula.

Case VI. Acute Diverticulitis of Sigmoid; Cecostomy; Death from Mesenteric Thrombosis.

White male, aged fifty, admitted February 20, 1920, suffering from indigestion, constipation, right upper quadrant pain and insomnia. Five years before a gallstone had been removed by cholecystostomy. His stool examinations showed no blood. Proctoscopic study showed marked spasticity at the rectopelvic junction and marked rectal constipation. Medical treatment directed toward the constipation gave the patient considerable relief and he returned home March 1st. On May 13th, he returned to the Sanitarium with symptoms of an entirely different character—frequent stools with blood and mucus during the last ten days, progressive loss of weight and strength, severe pain in the region of the coccyx. As many as fifteen bowel movements occurred daily, consisting

Fig. 16. (Case vii) A few diverticula retaining barium from opaque meal of three days previous, shown in relation to enema-filled colon. Extraordinarily few sacculations detected, considering the operative findings (see Figures 18 and 19).

Fig. 17. (Case vii) The same diverticula of Figure 16, after the patient has tried to evacuate opaque enema.

chiefly of mucus and blood. Hemorrhoids had developed. Roentgen-ray examination showed diverticulitis of the colon involving particularly the iliac and the upper portion of the pelvic loop (Fig. 15). On account of the acuteness of the situation, medical treatment was recommended to allay the irritation of the colon before taking the case to surgery.

The patient did not consent to surgery until July 27, 1920. At operation the colon was found to be the seat of numerous diverticula, most of them rather small. There were several areas of induration in the mesocolon. Under the circumstances of the case it was deemed wise to do a cecostomy instead of a resection. A colon tube was inserted through the rectum well up into the sigmoid and left in place. One epiploic appendage was removed for pathological study. There were so many adhesions in the right upper quadrant that the gall bladder could not be identified. There was a diverticulum of the bladder, 1½ in. in diameter and 2½ in. deep. This was inverted and sewed in place with a double row of sutures. The patient died August 19th of a mesenteric thrombosis, demonstrated at autopsy.

The writer and many others have repeatedly referred to the frequent coexistence of diverticula elsewhere in cases of colonic diverticulosis. We have frequently demonstrated in the same patient sacculations in the bladder as well as in the colon and in other parts of the alimentary tract, and we have exhibited the records of one patient with diverticula of the esophagus, duodenum, small intestine, colon and urinary bladder. This constitutes a good reason for using the term "diverticulosis" in describing this condition, especially when there is no good reason to believe that secondary inflammatory states have arisen.

Case vii. Diverticulitis of Sigmoid with Recurring Attacks Simulating "Left-Sided" Appendicitis; Resection; End-to-End Anastomosis.

White female, aged fifty-five, admitted November 30, 1922, complaining of general ill health, indigestion with hyperacidity, vague

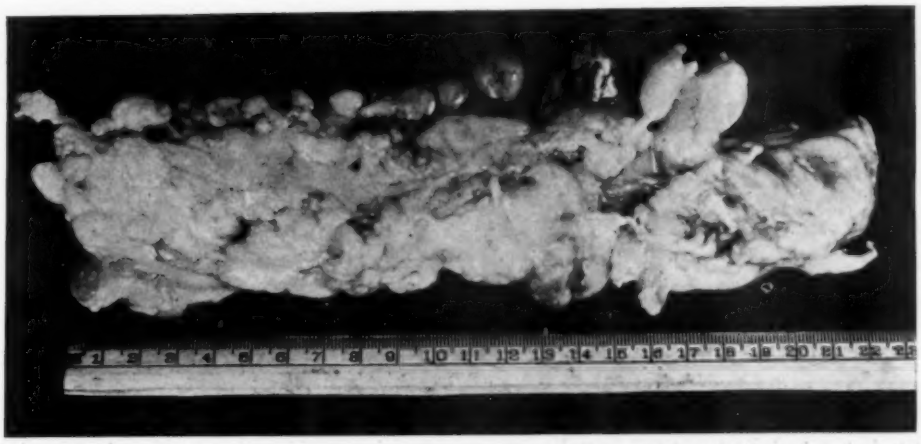

Fig. 18. (Case VII) Gross appearance of operative specimen of diverticula-laden sigmoid.

joint symptoms, recurring attacks of lower abdominal pain associated with irritability of the bladder, abdominal distention, fever, nausea and occasionally vomiting. She denied constipation, saying that the bowels usually moved twice daily without cathartics, but repeated proctoscopic examination showed a large amount of residual feces with rectal stasis.

Examination resulted in the following abnormal findings: peridiverticulitis of sigmoid (Figs. 16 and 17) with recurrent acute attacks, moderate vascular hypertension, chronic maxillary sinus infection and internal hemorrhoids. The leucocytes numbered 6,600.

In view of the history of repeated acute attacks as above described and the discovery of the diverticula of the sigmoid, operation was recommended, but was declined by the patient. Indeed, the recommendation was not pushed for the reason that the diverticula were apparently rather few in number, confined to 4 or 5 inches of the pelvic colon and not associated with signs or symptoms of obstruction. True, one of the diverticula measured 1.2 cm. in diameter on the roentgenogram, and retained barium for many days. Advice was given as to prophylactic measures for home treatment and the patient left the office expecting to return home the following day.

During the night there occurred another of the acute attacks which constitute the most interesting feature of her history, the temperature reaching 101.2°F., and the leucocyte count 27,300. There was extreme lower abdominal pain, muscular rigidity and nausea, so that the patient decided to undergo operation as soon as it was feasible. Meanwhile medical treatment as indicated in the preceding pages was instituted.

The following additional important facts of history were elicited: At the age of twenty, she began to have intestinal colics, the beginning of which she attributed to an attack of "ptomaine poisoning." After this she experienced intermittent attacks of colic and intestinal distress which often came on during a meal, obliging her to stop eating. After that she had attacks of diarrhea every summer. It was discovered that she ran a low fever most of the time. The frequent attacks of intestinal indigestion continued with periods of freedom from symptoms. Sometimes the attacks came every other day for a week or more and then there would be an interval of quiescence for two or three months. She was not conscious of any abnormally high temperature. Several physicians thought she had tuberculosis of the intestines but could find nothing to support such a diagnosis except the high temperature.

About a week later (December 18, 1922) the pelvic colon was exposed and found to contain multiple diverticula. The secondary manifestations of diverticulitis were apparent; the pelvic colon was adherent in three places, the epiploic appendages were edematous and much enlarged, and the sigmoid for a distance of about 25 cm. seemed heavy and rope-like. Thirty cm. of sigmoid (Fig. 18) was removed down to within 3 cm. of the peritoneal reflection, and end-to-end anastomosis done over a tube. The patient left the hospital on January 22, 1923, after a fairly stormy convalescence, especially during the first five or six days.

The pathological report (by A. S. Warthin)

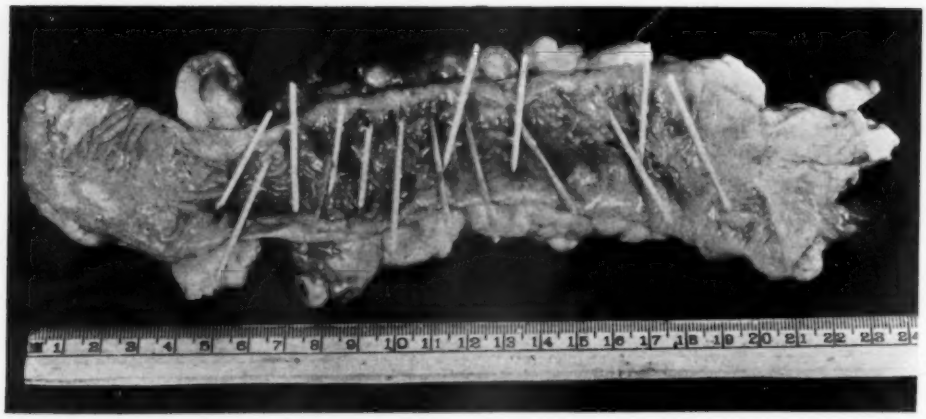

Fig. 19. (Case VII) The opened bowel, with matches inserted into larger diverticular orifices.

follows: Gross Pathology. Portion of intestine 30 cm. in length. The most important pathological change externally is a marked overdevelopment of the epiploic appendages which show a very marked lipomatosis. Some of these have an elongated pedicle and a distinct appendix-like shape. They measure from 1.5 cm. to 3.5 cm. in length and from 1 to 2.5 cm. in breadth or in diameter.

The majority of these show the appearance of adipose tissue, light yellow in color, but others show marked congestion and are of a firmer consistency. The mucosa of the intestine shows multiple small openings into small diverticula which extend into the epiploic appendages.

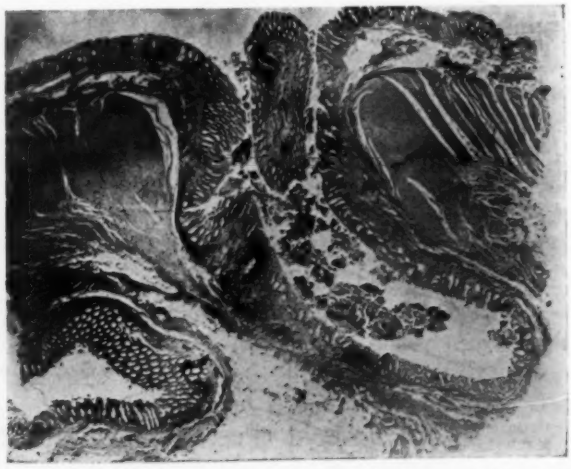

Fig. 20. (Case VII) Photomicrograph of one of the sacs of the specimen shown in Figures 18 and 19, indicating that they are true diverticula.

The largest of these, fifteen in number (Fig. 19) are large enough to admit easily a toothpick. The diverticula vary in length, the longest one, extending into the largest epiploic appendix, being over 2 cm. in depth. The others measure about 1 cm.

The opening into these diverticula is crater-like with a small central opening. The mucosa about this opening appears perfectly normal and there is no evidence to the naked eye of erosion, ulceration or inflammatory reaction. Likewise the lining of the diverticula presents the appearance of the normal mucosa. No abnormal contents were found in these small diverticula. They were either empty or contained mucus. The epiploic appendix into which the largest diverticulum extends shows the most marked hyperemia.

The adipose tissue of the mesentery attached to the intestine shows hyperemia or hemorrhage.

Pathological Diagnosis. These are true diverticula (Fig. 20) with a projection of the mucosa through the muscle coats, the tip of the sac being covered only by the serosa, subserosa and muscularis mucosa, submucosa and mucosa, constituting a true protrusion of the mucosa through a defect in the muscularis. The sac is lined by an atrophic mucosa. The diverticula contain mucus and bluish-staining, granular material (barium?). There is no inflammatory reaction in the wall of the sac. In the mucosa of the diverticulum there is one large lymph node and one smaller one.

One year later the patient was examined by way of inventory with the finding of an annular rectal stricture, occurring at the site of the end-to-end anastomosis. She submitted to a series of dilations which finally gave relief. The general condition was very satisfactory. There had been observed no further elevation of temperature and no further diarrhea.

One cannot help remarking on the relative severity of the lesion in this case which seems quite out of proportion to what one would anticipate in consideration of the small number of diverticula visible in the roentgenogram. This teaches the lesson that the severity of a diverticular lesion cannot be judged from the number or size of the diverticula visualized in the roentgen-ray examination. Especially is this true in those cases with tumor formation. The tumor is due to the deposit of fibrous tissue around the diverticula and to the edema of the epiploic appendages. Very often there can be traced through these tumors narrow channels representing diverticula, channels of such narrow dimensions, scarcely admitting a small probe, that they rarely lead to cavities of any size.

A perusal of the report of the pathologist, who knew, of course, nothing of the history of the patient, would indicate a mild case, out of all proportion to the actual clinical behavior and the operative findings.

Fig. 21. (Case VIII) Peculiar displacement of small intestine away from left inguinal region, due to unusually heavy, rope-like sigmoid, with edematous, fat-laden epiploic appendages, forming mass of considerable proportions.

Case VIII. Sigmoid Diverticulitis with Mimicry of Duodenal Ulcer; Rupture of Diverticulum; Emergency Operation (Simple Drainage); Cure.

White male, aged fifty-two, was admitted March 12, 1923, with a history of recurring duodenal ulcer, for which medical treatment had been twice given. For many years he had been having much gas distention. Four years before admission he began to experience abdominal pain sometimes relieved by eating and always relieved by soda, but he was relatively free from pain when resting. Laxatives had been used for constipation. On admission his pains were not controlled by food; the distress was fairly constant, and was made worse by exercise. Physical examination showed marked epigastric tenderness, especially over the gallbladder region. On account of numerous previous roentgen-ray studies, roentgenological study was ordered for the upper abdomen only. This showed an inconstant deformity of the duodenal bulb, no definite duodenal ulcer, and (a thing which was not noted until later) a curious displacement of the small intestine away from the left iliac fossa to a degree much more pronounced than usual (Fig. 21). A diagnosis of duodenal ulcer was finally adopted and the patient once more put through the usual medical treatment for this condition. Because of the rather high grade of intestinal stasis, particular attention was paid to its treatment. About May 15th, the patient returned for a continuation of treatment for his intestinal stasis, planning to leave for home again in about a month. The evening before his intended departure, he had a final sigmoidoscopic examination at about 5:30; at about 6:30 while seated at table in the dining room he was seized with such sudden, excruciating abdominal pains that it was at once apparent a serious condition had developed. There were rigid abdominal muscles, nausea, vomiting, cold perspiration, pallor, and rapid pulse. After a brief delay consent was given for operation, which was done at about 10:00 P.M.

The operation (June 13, 1923) revealed multiple diverticula of the sigmoid with a perforation low down near the peritoneal reflection at the site of one of the diverticular sacs. The sigmoid was adherent to the bladder and to the left anterior abdominal wall by numerous attachments of the epiploic append-

FIG. 22. Irregular filling defect in sigmoid colon characteristic of carcinoma with numerous diverticula in vicinity. Carcinoma due to diverticulitis (?). Diverticulitis due to carcinoma (?). Associated lesions (?).

FIG. 23. (Case X) Characteristic roentgenologic appearance of diverticular tumor, extremely hard to differentiate from carcinoma of sigmoid.

ages. The adhesions were freed sufficiently to permit exteriorization of a part of the sigmoid loop in preparation for a possible colostomy, and a cigarette drain was placed in the depths of the true pelvis. Within a few days it became evident that a colostomy would not be necessary, so the exteriorized loop of sigmoid was allowed to drop back into the peritoneal cavity. In spite of a greatly prolonged convalescence, due to postoperative bronchopneumonia, final recovery was complete and no further symptoms have called attention to the diverticula. The patient was seen early in 1928, at which time cholecystography revealed a large gallstone which doubtless has been present for years and perhaps explains the "duodenal ulcer" for which he took medical treatment on various occasions.

CASE IX. Carcinoma of Sigmoid Apparently Superimposed on Diverticulitis; Resection of Sigmoidal Tumor Together with the Fundus of the Bladder.

White male, aged fifty-seven, admitted August 22, 1926, with a history of colitis, with mucus and slightly bloody stools, dating back about five months. The stools were formed and it had not been necessary to use laxatives. Unusual gas distention of the abdomen had been a troublesome symptom.

Roentgen-ray study confirmed the presence of a sigmoidal growth having the appearance characteristic of carcinoma, and in addition multiple diverticula of the colon, more numerous in the sigmoid in the vicinity of the filling-defect (Fig. 22). On account of the history a tentative diagnosis was made of carcinoma associated with diverticulitis, and operation recommended. The hemoglobin was 80; red cells, 4,500,000, and white cells, 5,100.

Operation October 1, 1926, revealed a normal liver, gall bladder, duodenum and stomach, and a fist-size tumor which had the external appearance of carcinoma, but accompanied by a number of diverticula, some of them showing inflammatory reaction about them. Hope was entertained that the tumor might prove to be inflammatory only. The fundus of the bladder was involved over an area of 20 or 25 sq. cm., necessitating resection of a portion of the bladder together with the sigmoidal tumor. About 20 cm. of sigmoid was removed, con-

tinuity of the bowel being restored by end-to-end anastomosis over a large rubber tube. Pathological report: advanced annular adenocarcinoma.

The patient made an excellent recovery and to date has had no symptoms referable to the intestine or bladder.

Case x. Sigmoid Diverticulitis, with Tumor and Obstruction; Question of Carcinoma; Colostomy.

White male, aged sixty-seven, admitted March 21, 1928, suffering from soreness in the epigastrium, nausea but no vomiting, general weakness, loss of appetite, strength and weight, and nocturia with difficulty in starting urination. The present illness started four weeks before admission with chills, elevation of temperature and epigastric discomfort and pain. The patient insists that his previous health had been good; he never had any indigestion or constipation alternating with diarrhea, and had never observed blood in the stools. In view of the extreme upper abdominal distress, carcinoma of the pancreas or a gall-bladder lesion was suspected. A Graham test showed "absence of the gall-bladder shadow." A urethral stricture accounted for the urinary difficulty. Roentgenograms of the colon showed multiple diverticula with definite signs of diverticulitis in the sigmoid (Fig. 23). There was a definite filling defect and apparently a cavity about 2 cm. in diameter connected with the lumen of the sigmoid by a definite fistulous tract. Proctoscopic examination showed no sign of malignant growth and there was no visible or occult blood in the stool.

The abdominal symptoms were so strongly in favor of an upper abdominal lesion that we finally did an exploratory operation on the upper abdomen. The gall bladder was found buried in adhesions which bled very easily on separation. The common duct was finally found and explored but no stones were felt. The head of the pancreas was soft. Stomach and duodenum were normal except for adhesions. A tumor of considerable size was palpated in the sigmoid, but in view of the history, the definite proof of diverticulitis with the presence of an extensive rather than a localized filling defect and the negative sigmoidoscopic examination, it was concluded that the tumor was probably benign and due to diverticulitis. The gall bladder was removed, and fourteen days later, through a left inguinal incision, the sigmoidal tumor was exposed with the hope of dealing with it by the technique of Mikulicz. On examination of the tumor more carefully under inspection and palpation, however, it was found to be so infiltrated and so very extensively adherent to the bladder in the region of the left ureter that we decided to do a colostomy in lieu of resection. Accordingly, a left inguinal colostomy was performed under the strong impression that the lesion was not malignant, believing that within a few months time the tumor would disappear. This patient has made an excellent operative recovery, but the case is too recent to judge the final outcome.

CONCLUSIONS

1. Emphasis is placed on diverticulitis as opposed to the relatively harmless condition of diverticulosis.

2. Cases of diverticulitis are classified as (a) enterospasm type, (b) hyperplastic type and (c) pseudoappendicitis type.

3. Outstanding symptoms are detailed and special attention called to the mimicry of carcinoma of the colon, appendicitis, gall-bladder disease and even duodenal ulcer.

4. Roentgenological study supplies the decisive proof of the existence of diverticula and furnishes many signs indicating the transition from the stage of diverticulosis to the stage of diverticulitis. There are three roentgenographic signs of diverticulitis: (a) the small rounded shadows due to the retention of opaque material in the diverticula (LeWald, Carman, Case); (b) the signs of the prediverticular stage (George and Leonard, Spriggs and Marxer), and (c) the characteristic displacement of small intestine loops away from the left iliac fossa by the fat-laden, epiploic appendages producing a rope-like sigmoidal mass (Case).

5. Prophylactic measures are urged and carefully detailed, with the idea that one can definitely deter the transition from the harmless condition of diverticulosis to the dangerous condition of diverticulitis.

6. Medical treatment is appropriate and preferable to surgery in a large group

of cases, and as a preparatory measure in many cases in which surgery is sure to be ultimately needed. Diet is discussed.

7. Surgery is indicated as the treatment of choice only in severe cases. Because of the potentiality for trouble the diverticula-bearing gut should be resected when practicable, but if it is not possible to resect, the indication is for a colostomy or for an exclusion operation. Reference is made to Mummery's suggestion to wrap the diverticular area with omentum. In tumor cases simple colostomy often leads to disappearance of the inflammatory mass. In abscess cases or when the epiploic appendices are acutely inflamed, simple drainage is indicated.

8. Ten detailed case reports with illustrations illuminate the points brought out in reference to diagnosis and treatment of colonic diverticulosis, diverticulitis and peridiverticulitis.

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PLICATION OF THE HERNIAL SAC

IN OPERATING FOR FEMORAL HERNIA

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THE views of surgeons as well as those of internists are constantly changing, often undergoing a complete reversal, but on one surgical subject at least there has been no change of opinion since La Quin observed nearly two and a half centuries ago that the successful treatment of femoral hernia was much more difficult than that of inguinal hernia.

This question of dealing with femoral hernia has been of special interest to surgeons because of the fact that mechanical treatment by means of a truss is never satisfactory and is always more or less dangerous. The fitting of a truss for femoral hernia is difficult and when what seems a perfect fit has been made, the truss is certain to be displaced by movements of the muscles of the upper part of the thigh causing risk of strangulation and is a source of constant inconvenience and annoyance to the wearer.

Still another weighty objection to the mechanical method is that it never effects a cure. The surgical method being thus the only feasible plan for dealing with this defect, many efforts have been made to solve the various problems which the operation presents and numerous methods have been suggested. Interest has especially focussed on two steps, the treatment of the sac and the closure of the femoral ring. This paper relates wholly to the question of disposal of the sac.

The methods of dealing with the hernial sac proposed by various distinguished operators have been about as diverse as possible. The famous Billroth of Vienna, whose work the writer watched during the winter of 1883–4, opened the sac by a simple incision but did not remove it.

Lawson Tait, with whom the writer worked in 1889, operated through an abdominal incision and incised the sac only when adhesions were present, closing the ring with horsehair sutures. Socin excised the sac. Macewen twisted it and pushed it up into the abdominal cavity. Marcy excised the sac after carefully freeing it from adherent structures.

More than thirty years ago (1894) the writer, after trying various other methods, adopted a new plan of dealing with the sac which he described in a paper read before the Michigan State Medical Society at its annual meeting for 1896 and which was printed in the proceedings of the society for that year. From this paper[1] the following paragraphs are quoted:

> Two years ago when operating on a case it occurred to me that an improvement might be made by turning the neck of the sac upward. I accordingly adopted the following procedure.
>
> After transfixing and ligating the sac, instead of cutting all the ligature ends short, I left two of them hanging, then passed an aneurism needle from below upward along the canal and just outside of the hernial sac (hence extraperitoneal). I caused the blunt end of the needle to press outward at a point about 1½ in. above the border of the femoral ring. Carefully cutting down upon the end of the needle, I slipped a loop of silkworm gut through the loop of silk with which the needle was threaded and then I pulled the aneurism needle back, dragging the loop of silkworm gut back with it, and the long ends of the ligature employed in tying the sac were slipped through the loop and thus pulled upward through the opening above the ring by making traction upon the ligature ends. I was thus able to drag the stump of the sac upward to a point above the internal opening of the femoral canal and at the same time to fold the sac upon itself, thus obliterating the passage at

[1] Kellogg, J. H. A new method for the radical treatment of femoral hernia. *Tr. Michigan State Med. Soc.*, 1896, xx.

the internal ring instead of simply closing it at the external ring. In dragging the mouth of the sac upward I also took pains to pucker and tie the surrounding faciae and other tissues which were drawn upward with the sac along the femoral canal by the successive application of three or four ligatures. In this manner I was able to fill the canal with consolidated tissue; the stump of the sac was fixed in its upturned position by threading each ligature end upon a needle and passing them through the tissue in such a way that by tying

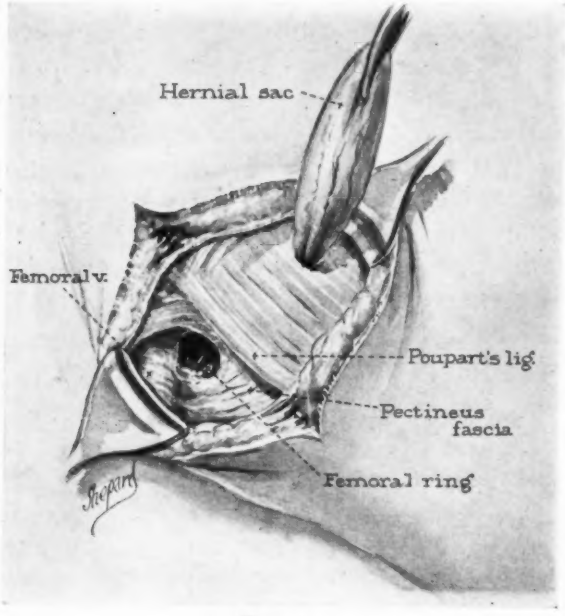

Fig. 1.

them the small opening through which they were first drawn was firmly closed. Sutures were then introduced and the wound was closed and treated in the usual way.

This plan succeeded so well that I have since adopted it in all cases of femoral hernia upon which I have operated. In one of these cases I was performing a laparotomy at the same time, and so took the opportunity to notice the effect upon the internal opening of the femoral canal produced by dragging the stump upward. The opening in this case was large enough easily to introduce the tip of my little finger from the peritoneal side. After the neck of the sac had been drawn upward and secured in place, the peritoneal end of the canal was found completely obliterated and it was scarcely possible to locate it. It was represented simply by the presence of a fold in the peritoneum. There seemed to be no possibility of a return of the hernia and the subsequent history of the case has shown the patient to be radically cured. I was glad to have this opportunity of verifying the effect of turning the mouth of the sac upward in the manner described.

In the several cases in which I have since employed this operation the results have been most satisfactory. In none has the rupture returned, although more than three years have elapsed since I first adopted the method.

A few years after the above paper was read, the writer was pleased to find in a then new edition of Kocher's Text-Book of Operative Surgery[1] a description of a very similar method of dealing with a femoral hernial sac in operating femoral hernia in which the sac is invaginated as well as turned upward. The following is quoted from the 1911 edition of the English translation of Kocher's work.[2]

The contents having been reduced, the apex of the sac is seized with curved "transposition-forceps" and invaginated, the point of the forceps being passed upwards immediately behind Poupart's ligament on to the anterior abdominal wall, and made to project through an incision (4 mm. long) in the outer pillar of the external abdominal ring. The sac is then forcibly pulled out with artery-forceps, transfixed at its base, ligatured, and removed in the same manner as was described in inguinal hernia. The stump is buried and the small opening in the aponeurosis closed with a suture.

Kocher later adopted the plan of twisting the sac, ligating and folding it upward, while Ferguson, Macewen and Bishop simply twisted the sac and folded it upward.

This plan of using the sac to reinforce the weak area in the abdominal wall seems rational and it is gratifying to note its adoption by various able surgeons with each of whom, so far as the writer knows, it may have been as wholly original as with himself.

Figure 1 so well illustrates the essential features of the method that no detailed explanation is required.

[1] Kocher, T. Chirurgische Operationslehre. Jena, G. Fischer, 1897, pp. 199–203.

[2] Kocher, T. Textbook of Operative Surgery. N. Y., Macmillan, 1911, pp. 199.

NEUROLOGICAL COMPLICATIONS IN SURGERY

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THE neurologist frequently is in the fortunate position of consultant on problem cases. As patients are often referred by him to the surgeon, and to him by the surgeon, he is enabled to gather cases which in themselves are rare but collectively may be instructive in showing lurking dangers.

Among complications which are well-known and hence only to be mentioned in passing are the introspection and somatic fixation seen in psychoneurotics following surgery, nerve palsies from setting of dislocated limbs, aphonia after thyroidectomies, radial nerve injuries in extended arms following Trendelenburg posture, and Erb-Duchenne's paralyses from podalic extractions.

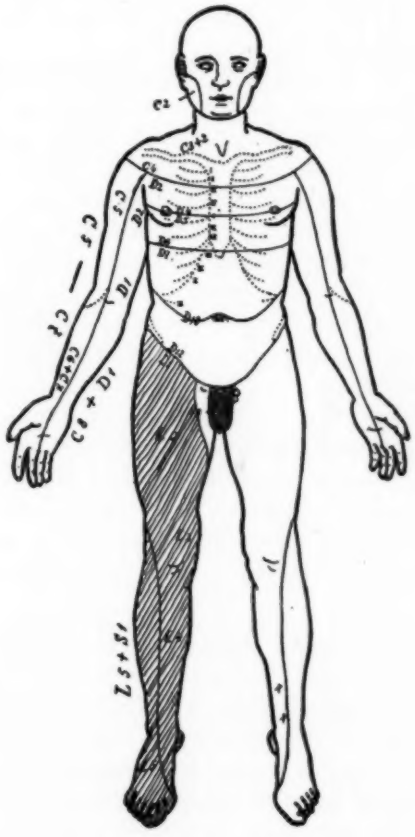

FIG. 1A.

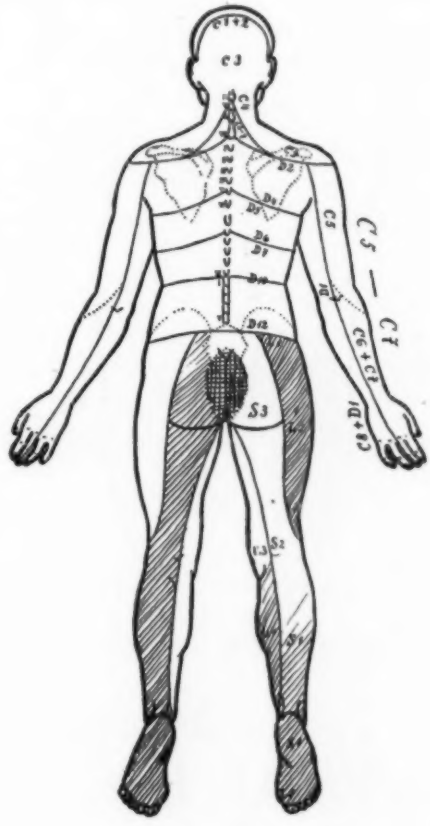

FIG. 1B.

FIGS. 1A and B. Case II. Dark shading represents total anesthesia, light shading hypesthesia at time of first examination.

It is not my purpose to present here common complications but rather the unusual and little-discussed cases. Those presented have not been gathered from this clinic alone but are the most instructive and uncommon which have come to our attention.

CASE REPORTS

Case I. Miss L. B., nurse, aged thirty-five, of a neurotic temperament but otherwise complaining only of rectal discomfort, was operated upon under gas anesthesia. Four large internal hemorrhoids were removed by the ligation method.

During the operation the lower limbs were suspended in stirrups. An inexperienced assistant, unnoticed, leaned against the right limb somewhat during the fifteen or twenty minutes of the operation.

When the patient recovered consciousness

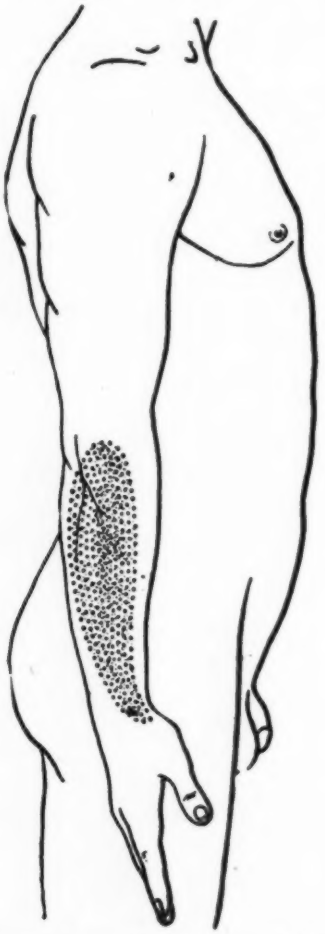

Fig. 2. Cutaneous anesthesia in complete section of the musculocutaneous nerve. (From Jelliffe and White, Diseases of the Nervous System. Phila., 1919.)

she could not raise the right foot above a right angle with the leg. On the sixth day when she attempted to walk she had poor control of the right foot and a foot drop. Examination disclosed tenderness along the peroneal trunk and the peroneal group of muscles. There was no anesthesia but considerable pain, which was not relieved by any of the usual mechanotherapeutic means. Massage and electrical stimulation were given and the function slowly returned, but even after eleven months the tendency to foot drop persisted.

Case II. Mrs. I. T., aged thirty-six, was referred to a surgeon for perineoplasty, which was done under lumbar anesthesia. When this began to wear off the patient complained of severe pain in the tip of the coccyx and in the sacral region. This continued unabated for two weeks and was relieved temporarily by heat but not in any other way except by opiates. With the pain came a saddle-shaped area of total anesthesia in the perineum and buttocks, (see Fig. 1, A and B) rectal and vesical insensibility, and the patient became involuntary to urine and feces.

When she was seen two weeks after operation the foregoing was confirmed but there was in addition hypesthesia in the first and second sacral areas on the left and all lumbar segments on the right. The lumbar segments had escaped on the left, while the first and second sacral segments had escaped on the right. The pain was greatly increased by raising the trunk, straining, coughing or sneezing. A diagnosis of a cauda equina lesion was made, probably hemorrhagic. Improvement has been steady but slow. Five weeks from the onset, there was marked sensitiveness in the area formerly totally anesthetic. The other segments had returned to function but the patient walked clumsily. In six months there were still a few remnants in the form of hypesthesia.

Case III. Mr. A. H. S., aged seventy-one, suffering from cardio-vascular-renal disease and maxillary sinusitis, was operated upon for drainage of the sinus. After local anesthesia the trocar was inserted in the usual way and air was gently forced into the sinus. Abundant discharge of pus through the natural sinus opening occurred. When this had drained, a little more air was injected but the patient immediately complained of "feeling funny." His head was lowered, all apparatus was removed and he was asked whether he wished to be carried to a chair or preferred to walk. He chose to walk but found himself unable to move his lower extremities. The arms were weak. The man had a thick, bulbar speech and some dysphagia. Examination revealed a diplegia with a bilateral Babinski reflex, which disappeared in four days. A vascular spasm in

the medulla was diagnosed. In two weeks the patient was as well as before.

Case IV. R. A., a boy aged fourteen, was taken with attacks of pain in the region supplied by the fourth to the seventh dorsal segments on the left side. The pain completely incapacitated him for a day at a time. There was constant exquisite hyperesthesia to light touch, even clothing causing severe pain. Bouts of pain with continuous hyperesthesia continued for four years, when the sensory roots in the segments named were cut by a neurologic surgeon. The pain in the original four segments was replaced by total anesthesia but it soon recurred in the segments above and below. Bleeding occurred into the spinal canal and gave rise in twelve hours to a total paralysis below that point. A second operation to relieve this condition showed that there was a general oozing; the patient was a hemophiliac. He was still paralyzed one year later.

Cases V, VI, VII and VIII. These were all women operated upon by four different surgeons, but one description will apply to the four cases.

Following the operation it was found that the patient had one weak arm. She was entirely powerless to flex the elbow unless the forearm were first pronated and then flexion was still weak. In addition to the weakness there was an area of numbness and anesthesia as shown in Figure 2. The diagnosis was simple—musculocutaneous nerve paralysis. But the explanation of the mechanism by which the lesion was produced was not so simple.

Radial nerve lesions are well known in cases where the arm is inadvertently allowed to dangle during a pelvic operation in the Trendelenburg posture. But this had not occurred as the arm in question had been strapped to a board to obtain blood pressure readings. An analysis was much facilitated by having the neurologist placed in a similar but exaggerated posture for a few moments. It was found that an arm abducted to a right angle with the body and then pressed backward would give the precise conditions to cause stretching of the musculocutaneous nerve. Therefore, if the board supporting the arm were stuck under the table pad and a similar pad were not placed on the board, a musculocutaneous nerve paralysis resulted. All patients recovered and no similar cases have resulted since the technique was changed.

Hardly any comment is necessary. I have nothing new to offer in preventing such complications as resulted from the sinus drainage or from the lumbar puncture. The other types of complications may obviously be prevented.

SOME UNPREDICTED FEATURES IN EXTIRPATION OF THE TEAR SAC

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BY necessity a textbook on surgery must describe a typical surgical procedure for each pathological entity. The variations, complications and less frequent findings are usually mentioned as well. When one essays a given operation, however, he must always be on the alert for the unexpected and for the rare. The following four cases belong to this group, observed during the course of the extirpation of the lacrymal sac.

CASE REPORTS

CASE I. A blind fiddler was brought in by a philanthropic friend to learn whether or not vision could be restored in either eye. There were destructive lesions of the tissues of the anterior segment of the eyes resembling the sequelae of trachoma; pannus, double symblepharon posterius, trichiasis and corneal opacities. The pus in the right cul-de-sac seemed to be coming from an infected chalazion that bulged the outer lid surface and opened through the conjunctiva of the upper lid near its margin. On pressure over the canaliculi there was no discharge. After anesthetizing the skin and subcutaneous tissues, a horizontal incision was made over the apex of the swelling in the skin of the upper lid and the tumefaction in its envelope was dissected out. It was a surprise to find that the dissection led under the skin but above, rather than under, the internal canthal ligament and down through the lacrimal fossa into the nasal duct. The duct was curetted. The content of the lacrymal sac was mucopus. Stitches were placed in the skin incision and a pressure pad was applied over the lacrimal groove. Healing by first intention ensued.

CASE II. Mrs. J. A., aged seventy, was referred for attention to an acute left dacryocystitis. The lower punctum was closed. The upper was partially closed. With a cambric needle the lower punctum was pierced and a No. 1 Bowman probe was easily placed up to the entrance into the sac. A No. 2 probe entered the sac, and the sac was irrigated with warm boric acid solution. In a few days a No. 3 probe was passed into the lower canaliculus and a No. 1 probe through the upper one. Daily irrigations were made. Two per cent mercurochrome was left in overnight. Hot and cold compresses were applied at home. There was relief from pain, and the redness and swelling receded. However, after an absence of a few days, the patient returned with such an intense exacerbation that it seemed best to incise the sac. A small incision was made in the pointing area. With a lacrymal syringe the sac and nasal duct were irrigated. A wick was left in the wound and daily treatments were given until the inflammation in the surrounding tissue had subsided. But a few days after the wick was removed there was an ominous flare-up of the inflammation. Since the patient had pernicious anemia with cord involvement, the hemoglobin remaining below 40, it was with reluctance that we made our final decision to extirpate the sac.

Novocain and adrenalin were injected intradermally and subcutaneously in line with the former incision, into the deep tissues along the periosteum and about the base and dome of the sac. The skin was very friable. It was difficult to hold with forceps or speculum. The sac was large and tough and easily held. It was dissected out and the cavity swabbed with 2 per cent mercurochrome. On the floor of the cavity near the end of the fistulous opening there remained a small tag which looked like a piece of adherent sac. This was picked up with forceps and gently pulled off. At once the orbital fat began to ooze into the cavity. The removal of the tag had made a tiny opening in the septum orbitale. The fat was pushed back and held with cotton applicator while the lacrymo-nasal duct was curetted and swabbed with mercurochrome. Skin sutures were placed and a gauze pad was laid over the wound and held in position by a pressure bandage. The incision healed quickly. Redness of the skin of the lid, nose and cheek persisted for some time. The patient was seen every few days for two

months afterward. She had a crop of internal styes and a small infected retention cyst in the skin of the upper lid.

This case was of interest because we were forced to operate, although it was against our usual custom of not operating in advanced cases of pernicious anemia. The skin and septum orbitale were friable. There were no untoward results from replacing the hernia of orbital fat.

Case III. Baby H., aged one and one-half years, with left dacryocystitis which developed

Fig. 1.

two weeks after birth and later opened spontaneously, leaving a fistula (Fig. 1).

Under gas and ether anesthesia, to control the bleeding, 1 per cent novocain and adrenalin were injected intradermally and subcutaneously about the scar tissue and the lacrymal fistula which had opened just below the lower canaliculus. To act as a director, a No. 4 Bowman probe was passed through the upper canaliculus and through the sac into the lacrymo-nasal duct. The probe was left in this position during the dissection of the epithelium that had grown into the fistula.

An elliptical incision was made including the fistula. The skin of the fistula was held with toothed forceps while the epithelium was removed with the curved scissors from the sides of the groove into which it had grown. Any remaining epithelial cells were cauterized with a small pointed electrode. The probe-director prevented the scissors and electrode from coming in contact with the sac except at the fistulous opening. Two stitches were placed in the skin incision, the needle and sutures having been run through sterile paraffin oil. The lower canaliculus being patent only in the outer portion, the entrance through it to the sac was pierced with the small end of the Ziegler dilator. The probe-director was then removed from the upper canaliculus and the channel was irrigated with normal saline solution. Only a small portion of the solution passed into the nose; most of it found its way under the skin of the lower lid through the opening just made at the proximal end of the lower canaliculus. This was absorbed in a

Fig. 2.

few hours. This irrigation was repeated a few days later by way of the upper canaliculus. Silk isinglass plaster was placed over the skin sutures and a small pad and bandage were applied. Splints made of wooden tongue depressors fastened together with adhesive tape were placed on the flexor surface of each elbow to prevent the patient from pulling at the dressings. The stitches were removed on the fourth day. The wound had closed and the lacrymal passages were open. Now irrigation can be performed through either canal.

Case IV. Miss M. C. M., student, aged nineteen, entered the clinic for treatment for poor vision, epiphora, photophobia and the removal of a tumor of the right lower lid.

She stated that when about ten years old she had a severe inflammation of her eyes that

persisted for nine months and left her with poor vision and epiphora on the right. Gradually a swelling developed about the internal angle of the right eyelids. On examination of the eyes the picture of hereditary syphilis was seen in all the tissues; there was a diffuse cloudiness of the interstitial cornea with minute blood vessels visible with the loupe, iris pigment on the anterior capsule, a yellowish papilla with hazy borders, and in each retinal periphery a characteristic chorioretinitis. On the right

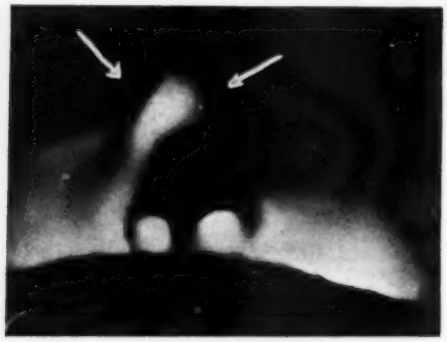

Fig. 3.

there was a congenital conus beneath the disc and situs inversus of vessels, so that the poorer vision of this eye could be due in part to these anomalies. The right lower orbital border was rounded and smooth; the left was thin and sharp and notched. Her face was rather flat but the nose was not the typical saddle nose. There was a non-inflammatory fluctuating mass (Fig. 2) on the right lower lid extending from the nasal wall to the mid-line of the lower lid, well past the maxillary malar suture. The puncta were clean; there was no discharge from them and none on pressure over them. The irrigating needle could be entered at either canaliculus but the fluid returned clear through the same canaliculus. There was an obstruction by pressure or otherwise, distal to the union of the canaliculi.

On transillumination through the mouth a brilliant glow was transmitted through the whole of this tumor-like mass (Fig. 3). It was suggested by a noted visiting ophthalmologist that the lesion might be a productive cyst from a gumma of the bone and that the luetin test would help to solve the problem. Both Wassermann and luetin reactions were positive.

The roentgenogram revealed no disease of the bones of the orbit or face.

For cosmetic reasons the patient wanted the tumor-like mass removed.

The skin of the right lower lid was cleansed with iodine and alcohol. Novocain and epinephrin were injected intradermally and subcutaneously along the upper border of the tumor, and a curved incision about one inch long was made through the skin and subcutaneous tissue, parallel to the orbital crest, from a point 4 mm. lateral from the internal angle of the eye. The thick capsule of the tumor presented at once. The skin margins of the wound were dissected from this mass and held with small toothed forceps. Novocain

Fig. 4.

was then injected beneath the subcutaneous tissue. The mass was removed with curved blunt scissors and spatula dissection with snipping of many tough connective tissue bands between the sac and the periosteum of the malar and superior maxillary bones. The pedicle of the mass led mesially and downward to the lacrymo-nasal duct and was excised after the dissection had been carried as far down as possible. The nasal duct was curetted of its mucous membrane well down to the floor of the nose. The cavity was swabbed with quarter strength tincture of iodine. Silk sutures and needles were run through sterile oil and five stitches placed. A rather long, round pad of tightly wound iodoform gauze was laid along the length of the wound and a pressure bandage was applied over all.

The mass proved to be a pure mucocele of the lacrymal sac. The wound healed by first intention. The transillumination after removal of the sac and its contents was very faint, almost nil (Fig. 4). The clear content of the colloid substance of the mucocele was evidently the source of the brightness seen on transillumination.

The case is reported because of the size and position of the cyst and the extent to which it had burrowed, and the rarity of a pure mucocele with brilliant transillumination, which transillumination faded with its removal.

FACTORS IN THE ADMINISTRATION OF ETHYLENE

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DURING the past four years ethylene has been thoroughly tested and has proved to be one of the best of our general anesthetics. This is at once evident by its widespread use in practically all the large surgical clinics. Its numerous advantages over other general anesthetics, as stated by Chipman,[1] are:

1. Patients quickly anesthetized and rapid recovery.
2. Reduced postoperative nausea and vomiting.
3. Absence of cyanosis.
4. Relaxation.
5. Period of analgesia and anesthesia.
6. Absence of sweating.
7. Absence of headaches.
8. Absence of gas pains.

To these we wish to add and emphasize the lack of excitation or stimulation of the nervous system, as shown by normal respiration and circulation, lack of muscular movement and sweating, and in nearly all ways the simulation of natural sleep.

Among the few contraindications to the use of ethylene is its explosibility, and yet, as several writers have observed, it differs very little from ether in this respect. It is probable that if accurate figures were obtainable, the ratio of fires and explosions due to ether would be found to be as high as those due to ethylene.

The danger of explosion has been ignored or made light of by some. This is likely to result in trouble sooner or later. On the other hand, in considering the danger of explosion of ethylene, we should not become frightened as some have and refuse to use what is probably the best anesthetic we have at our command today.

Explosions that have occurred seem to be largely due to static charges on either (1) the apparatus, (2) the anesthetist, (3) the patient or (4) those standing near. We believe there is little evidence from the explosions that have occurred to indicate that they could have been caused by internal causes such as:

1. Spontaneous explosion.[2] There seems to be abundant evidence that there is no danger from the pure gas under high pressure in the tanks, as many thousands of cylinders have been filled and shipped to all parts of the country.

2. We know of no evidence that it forms explosive compounds with copper and other metals as does acetylene.

3. The gas is now made of such high purity (99.5+ per cent) that it is very improbable that it contains any impurity which on contact with oxygen would increase the fire or explosive hazard.

Preventive measures then should consist in thoroughly dissipating by adequate grounding any charges that originate at any one of the above four points.

A successful system of preventing the accumulation of a charge, which is available at little expense and trouble, is shown in the accompanying illustration (Fig. 1). From the reducing valves (1) connected to the tank, a small insulated copper wire (2) runs along the gas tubes to the metal head of the anesthetic machine (4). The ends of the wire are soldered in place. The outside of the rubber bags (3) is covered with a metallic paint which is a good conductor. This establishes contact with the metal parts in several places. Within each rubber bag is placed about one pint of water. By means of the water in the bags and the film of moisture all over the inside of the bags, connecting with the metal tube to which the bags are attached, and by means of the moist cloth (12A)

connected to the metal frame at the back of the apparatus, any potential set up by the gas escaping under high tension through the reducing valves or by friction in the rubber tubes is at once grounded before the mixing of the ethylene and oxygen. The outside of the rubber tube (5) is coated with the metallic paint, thus dissipating any charge due to friction on this tube. Within the tube is a bare spiral copper wire soldered to metal at each end. thicknesses of moist gauze, which is much more pliable and easily adjusted. The anesthetist (9) is connected in the circuit by his hand on the mask (6). He is grounded and thus again grounds the circuit through the moist cloth (12B) upon which his feet rest or (12C) a moist cloth attached to his metal stool. The table (10) is connected into the circuit by the insulated wire (11) which is soldered to the metal head (4) and by means of a

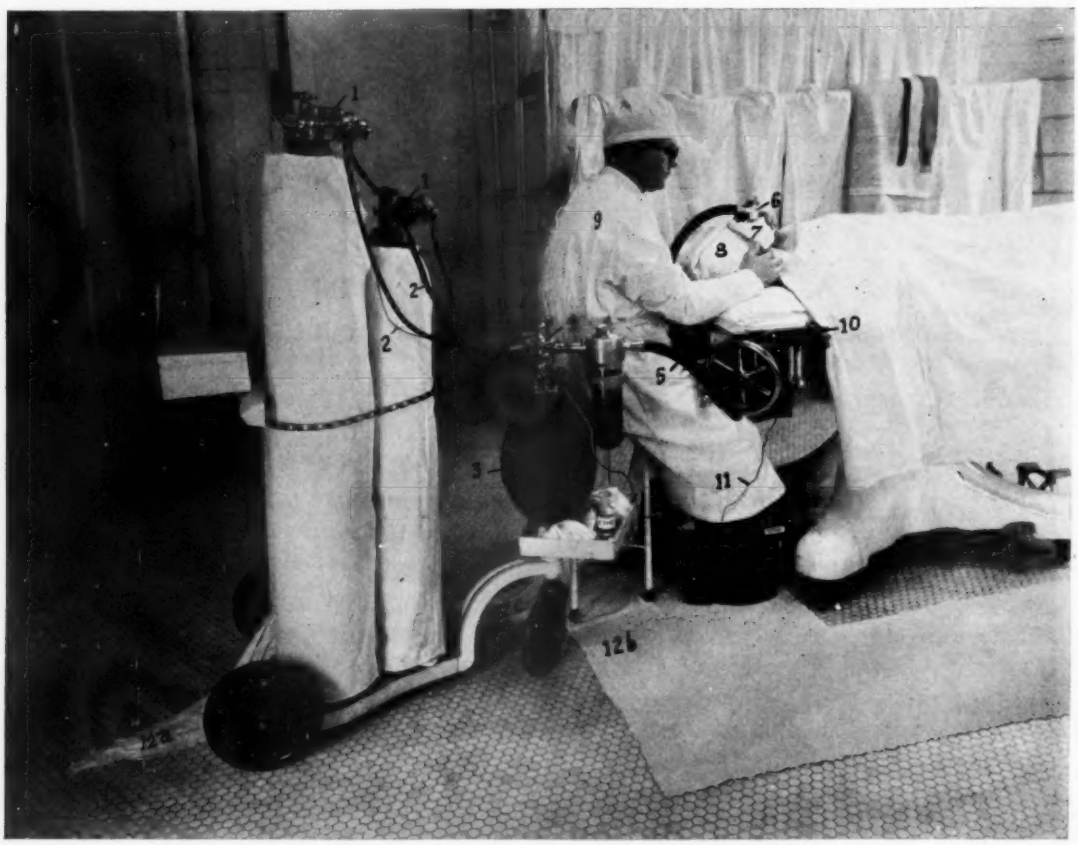

Fig. 1.

It has also seemed advisable to solder a connection to the metallic spiral in the wall of the rubber tube which prevents the tube from kinking. After the tube has been used some time this metal occasionally becomes exposed to the flow of gases within the tube. Before each operation, water is run through the tube and mask, leaving them wet. The metal of the mask (6) is thoroughly connected to the patient (8) by means of a wet towel (7) or several convenient battery clip is easily attached to the table. The table is also grounded through the adjustable metal leg (13).

The above description assumes the floor to be a good ground. This and the efficiency of all parts of the circuit are easily and thoroughly tested by means of a small static machine and electroscope.[3] In this way a charge can be placed at any point and its presence or absence shown by the electroscope. Cement and tile are

usually good conductors, especially if kept moist, but wood, linoleum and rubber-covered floors are poor conductors. Under such conditions a special system of grounding must be worked out. This is important for everyone knows how easy it is to produce a static spark on an insulated floor. This was strikingly brought to our attention recently. In an obstetrical department with linoleum floor, one of us just lightly brushed a rubber pillow with a sleeve and the next instant a spark about half an inch long jumped to the table.

Especial care must be taken to obtain thorough grounding in obstetrical departments as much movement by the patient, exposure of the rubber surface of pillows, pads, etc., and the frequent removal of the mask from the patient's face, result in considerable friction. We, therefore, coat the pillows and pads with a metallic paint and take care that they maintain contact with the table. With a little attention to proper grounding, we feel that ethylene is entirely safe and is the anesthetic of choice for obstetrical work, especially from the standpoint of the mother and child.

It is probably due to the humidity that some have been able to escape accident when using ethylene extensively without grounding precautions. But natural humidity is very changeable and cannot be depended upon in such an important matter. In many of the larger hospitals a forced system of ventilation is now used in the operating room. Two important results have been secured by this means. The air entering the room is passed through a water spray, the temperature of which can be controlled. Thus a high humidity is produced in which it is practically impossible to develop static and the temperature is kept constant even on the hottest summer days, making the working conditions very satisfactory.

In the system described above we believe the presence of moisture at several points is the most important single factor. In fact this alone would insure a large degree of safety.

It seems to us that the above precautions are not burdensome or so elaborate as to defeat their purpose. If they are taken, we believe they will eliminate such accidents as reported by Allen and Murray,[4] due to failure to completely turn off the gas or to a very rich oxygen mixture. With us it has become a simple routine, easily carried out and has proved entirely effective.

SUMMARY

1. Ethylene has proved to be one of our best general anesthetics.

2. Danger of explosion cannot be ignored. On the other hand we should not become frightened into refusing to use it.

3. A successful system for preventing explosions is described.

4. Emphasis is placed on the importance of moisture at several points in the use of the system.

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ACQUIRED
ELEPHANTIASIC SCROTUM
WITH CASE REPORT OF NEW PLASTIC METHOD

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UNDER the term acquired elephantiasic scrotum may be grouped the endemic cases in the tropics, elephantiasis tropicum, and the sporadic cases of temperate climates, elephantiasis nostras. The sequence of pathologic events producing tropical elephantiasic scrotum may be summarized as follows (Manson):

(1) Parent female filariae in the lymphatic system draining the scrotum.

(2) Obstructive fibrotic changes in the inguinal lymph glands and lymphatic trunks.

(3) Stasis of lymph in the scrotum ("lymph scrotum").

(4) Lymphangitis due to bacterial invasion through skin wounds, to toxins from the worm itself, or to products of the disintegration of microfilariae in the congested area.

(5) Imperfect absorption of the products of inflammation.

(6) Recurring attacks of inflammation from similar causes leading to gradual, progressive hypertrophy of the part.

The mechanism for the production of elephantiasis nostras is probably much the same, i.e., lymph stasis which may be due to bilateral inguinal adenitis, etc., chronic recurring inflammation, imperfect absorption of inflammatory products, and the final slowly progressing hypertrophy.

Tropical cases often attain enormous proportions. The largest reported by Manson[1] weighed 224 pounds. As ordinarily seen they range from about 10 to 20 pounds, although cases are commonly reported of 35,[2] 36,[3] 50[4] and 86[5] pounds respectively. Elephantiasis nostras as usually seen in the clinics of this country would not average much above 10 pounds, although occasionally one reads reports of enormous cases. Thus Windell[6] quotes a case of Campbell's, weighing 226 pounds! The interesting feature of this unusual case is that the patient wore an inguinal truss for twenty-five years. So it is probable that elephantiasis nostras has the same potential elements for enormous enlargement as the filarial elephantiasis. In fact these two types of the disease exist side by side in the tropics and resemble each other very closely. Even in their microscopic structure they are similar. As morbid processes they are histologically alike and differ only in the primary cause of the lymphatic and venous obstruction which initiates the process (Matas[7]).

Clinically, it appears that in the majority of cases of elephantiasis nostras the penis and scrotum are both separately and enormously enlarged. On the other hand in elephantiasis tropicum the penis is usually buried under the skin and subcutaneous tissue of the upper and anterior surface of the large scrotal tumor. This difference, then, although not constant, is seen often enough to warrant mention.

ETIOLOGY

Climate. It is well known that elephantiasis is common and endemic in the tropics, and that one of the most commonly seen forms is the elephantiasic scrotum. Matas[7] would have us believe that

> The reason why elephantiasis as a clinical entity is so much more frequent in the tropics is because the conditions which favor cutaneous infection as well as lymphatic obstruction are so much greater than in colder climates; greater exposure of skin areas, especially lower extremities, to traumatism of all sorts; greater

activity and consequent greater irritability of skin; universal presence of suctorial insects and parasites; greater frequency of eruptive diseases, etc.

Race. It is also significant that the majority of cases of elephantiasic scrotum occur in colored races. Anyone having practiced medicine and surgery among the dusky races of the tropics must have been impressed by the frequency of cases of fibrosis, fibromata and fibromyomata. Among these people the most carefully approximated surgical incisions become keloids sooner or later. So undoubtedly this racial characteristic of reaction to injury by fibrosis is of considerable etiological importance.

Filaria in Endemic Cases. Filaria Bancrofti with its resultant lymph stasis is certainly the initiator of many cases of scrotal elephantiasis tropicum. However, a large percentage of cases of "lymph scrotum" never develop elephantiasis. Manson[1] himself states that lymph stasis alone does not cause the disease and further that erysipelatoid inflammation, frequently recurring, is a well-recognized feature of almost every case. Some authors attribute more importance to filariae. Thus, Low (quoted from Matas[7]) asserts that if a lymphatic obstruction caused by adult filariae is followed by an attack of erysipelas, the filarial embryos are killed and their disorganization is a cause of the lymphangitis which culminates in elephantiasis.

Bacteriological Causes. In contrast to this view, Dubruel (quoted by Shattuck[8]), in observations extending over three years in Tahiti, found that while elephantiasis was common among the natives (one-twelfth of the population), filariasis was practically absent. He examined the evening blood in over two hundred cases with negative results and did not see a single case of chyluria. Cultures from his cases yielded staphlococci, streptococci and diplococci. He therefore concluded that recurring attacks of inflammation due to these organisms is the principal etiologic factor. Manson[1] recognized the difficulty of demonstrating the microfilariae in the night blood, as he was able to demonstrate them in only one out of fourteen cases of elephantiasis scrotum.

In regard to the sporadic cases encountered in temperate climates, most authorities are agreed that the exciting cause is recurring inflammation by pathogenic microorganisms of the streptococcal group. Unna[9] taught that the exciting bacteria remain latent in the tissues between attacks of active inflammation. If we accept the views of Le Dantic, Sabourand and Unna, and many others, the progressive fibromatosis which we recognize as elephantiasis nostras may occur independently of any stagnant state of the lymphatic or venous circulation and solely as a resut of repeated attacks of a streptococcal infection. (Matas[7]).

Syphilis and Tuberculosis. Syphilis is a rare cause for scrotal elephantiasis. Marshall[10] reported a proven case in a colored man in Tennessee. He mentions the rarity of the condition in America. In his article he has collected six other cases of proven syphilitic elephantiasis; most of these had positive Wassermanns and were cured by antiluetic treatment. Another more rare cause is tuberculosis (Gougerot[11]).

Miscellaneous Causes. Windell[6] wrote on genital elephantiasis following extirpation of inguinal glands, detailing two cases of his own and mentioning nine others which he collected from the literature. So we are again well warned that every skin incision should be carefully planned to avoid disagreeable results from scar, loss of skin sensation, lymphatic blocking, or severance of nerves or blood vessels (Speed[12]). Orr[13] reports a case following gonorrhea and bilateral inguinal lymphadenitis and Speed[12] reports one following drainage of suppurating inguinal adenitis.

PATHOLOGY

In acquired elephantiasic scrotum the skin is usually greatly thickened in the

most dependent portions of the tumor. It may be smooth and shiny with prominent pores or it may be coarse, thrown into folds, with a wart-like surface. There is usually a zone of rather solid subcutaneous edema between the diseased and the healthy skin. The whole mass is firm and brawny in consistency and on section has a blubbery appearance, which gives off a copious flow of lymph. The testicles and cords are found located at the upper and posterior part of the mass. In the majority of cases they are found to be in a healthy state. There may or may not be an associated hydrocele of the tunica vaginalis.

The histopathology of the skin is as follows (Matas[7]):

1. Mechanical blocking of veins and lymphatics.
2. Hyperplasia of collagenous connective tissue of the hypoderm.
3. Disappearance of elastic fibers of the skin.
4. Existence of hard lymphedema ("coagulable dropsy").
5. Chronic reticular lymphangitis caused by secondary and repeated invasion with bacteria of the streptococcal group.

The most striking pathologic change is hyperplasia of connective tissue. This is first apparent in the deeper layers of the skin. Then, penetrating to the subcutaneous tissue along nerves and vessels, the fibrous hyperplasia leads to atrophy of fat and muscle, finally replacing them entirely (Shattuck[8]).

CLINICAL CONSIDERATIONS

The onset of the disease is marked by fever; the skin of the affected part, the scrotum, becomes red and inflamed with small vesicles on the surface. These attacks of cutaneous infection frequently recur and each one leaves in its train a permanent distention of some of the lymphatics. The subcutaneous tissue is at first soft and edematous and pits on pressure; after a time it becomes hard and brawny, and the skin is either covered with vesicles and dilated lymphatics or in the later stages is eczematous, roughened, tubercular and horny (Bowlby and Andrews[14]).

This disease in the tropics is characterized by a large scrotal tumor suspended from the puboperineal region and having the penis buried within the mass. Over halfway down on the anterior surface is a small slit which represents the termination of the stretched out prepuce. The coarse thickened skin of the most dependent portions of the tumor fades gradually into healthier skin around the sides of the growth toward what might be termed the pedicle. Frequently groin glands are present and there may be an associated elephantiasis of one or both legs. It is often remarkable that so few symptoms are complained of by patients having huge elephantiasic growths.

The majority of cases of elephantiasis nostras exhibit enlargements of varying sizes of both penis and scrotum. In a case reported by Orr[13] the greatest circumference of the scrotum was twenty-eight inches and the penis seven inches. Such cases commonly followed bilateral inguinal adenitis of venereal origin. This was true of Orr's case mentioned above and also in one of Speed's.[12] In fact both of these patients had urethral strictures as well as bilateral inguinal adenitis.

TREATMENT

With the exception of the rare cases of luetic elephantiasis, the treatment of this malady is always surgical. Castellani and Chalmers describe a case greatly improved by compression bandages and injection of fibrolysin. But this method is not used today since it has failed to yield constant results.

There is no accepted technique in operating upon elephantiasis nostras. Lymphangioplasty as advocated by Handley is used alone or combined with other methods. Speed,[12] in operating upon a case of elephantiasis nostras through a central incision in the scrotum, removed several pounds of elephantiasic tissue from each

half of the scrotal tumor. He then tunneled from the scrotum subcutaneously to the suprapubic region on both sides, made small incisions over the upper ends of the tunnels, probed a 12 in. forceps up from below and pulled down three strands of braided silk beneath the subcutaneous tissues of each side. Keysser[15] describes a case that had been treated by Handley's method with failure four months previously. He reoperated and removed a portion of the anterior rectus sheath and turned down a portion of fascia, also utilizing the channels produced by the silk in the previous operation.

The following technique was utilized by Orr[13] in operating upon his case: Bilateral herniotomy incisions were made, the aponeurosis of the external oblique was divided above the cord, the internal oblique sutured to Poupart's ligament, the testicle drawn up, the tunica vaginalis opened, turned inside out, sutured behind the cord and upper epididymus and replaced. The external oblique was sutured beneath the cord and the wound closed in the usual manner. The most of the scrotal mass was amputated, leaving the testicles and sufficient skin for a new scrotum. This ingenious method forms an anastomosis between the superficial and the deep lymphatic vessels.

While in elephantiasis nostras it takes some efficient method of lymphatic drainage as well as removal of diseased tissue to produce a cure, it would appear that this is not the case in elephantiasis tropicum. In the latter condition it is known that complete ablation of all pathologic tissue is sufficient. The technique described by Manson[1] is widely employed. A rubber tourniquet is used as a figure-of-eight with the large loop about the patient's body and the small loop about the neck of the tumor. Shallow transverse incisions are made across the perineum and the pubis, their extremities being connected by lateral semilunar incisions. The channel of the stretched prepuce is slit through, the penis dissected free and the prepuce severed around the corona. A search is made for the testicle and cords, freeing them up to the external ring on each side. The neck of the tumor is severed close to the perineum and pubes, while the testicles and cord are retracted to one side. Flaps are closed over the testicles and the wounds are closed in the shape of the capital T. It is usually necessary to skin graft the penis later.

In studying over this technique it seemed feasible to work out a plan whereby primary flaps for the penis could be provided, together with ample skin for the formation of a scrotal sac. In doing this it is important that healthy skin always be used for the skin flaps. Since the postoperative fate of flaps is determined by an adequate blood supply, it is important that they be cut with a broad base, that subcutaneous tissues be preserved wherever possible, and that injury to the dorsal vessels of the penis be avoided. Furthermore the flap incisions should be located anatomically so that no twisting or stretching is necessary.

AUTHOR'S METHOD

Careful preliminary preparation is necessary. The patient is admitted to the hospital a week before operation. The tumor is kept slightly elevated during this time. He is given a daily bath, and the perineal region and the scrotal tumor are shaved. The day before operation he is given a sitz bath in a weak lysol solution, special attention being paid to the creases and the slit leading to the penis. The tumor is scrubbed with alcohol and half-strength tincture of iodine. A sterile towel is then tied about the enlargement. The morning of the operation he is given an enema and, as recommended by Bell, one hour previous to operation is placed upon the table with the scrotal mass elevated. No tourniquet is used as it is a hindrance in the formation of the flaps. The tumor and surrounding skin are thoroughly cleansed with alcohol and tincture of iodine. Beginning in the perineum (Fig. 1A) with the tumor

retracted onto the abdomen, a semicircular flap is marked out on each side of the tumor. These marks begin in the perineum about two inches in front of the anus and extend well up on each side of the growth, terminating about 1 in. below the external ring on each side. The incisions follow these marks and are made through the subcutaneous tissue, the flaps thus formed being dissected upwards to their bases (Fig. 1B). The large vessels met with are

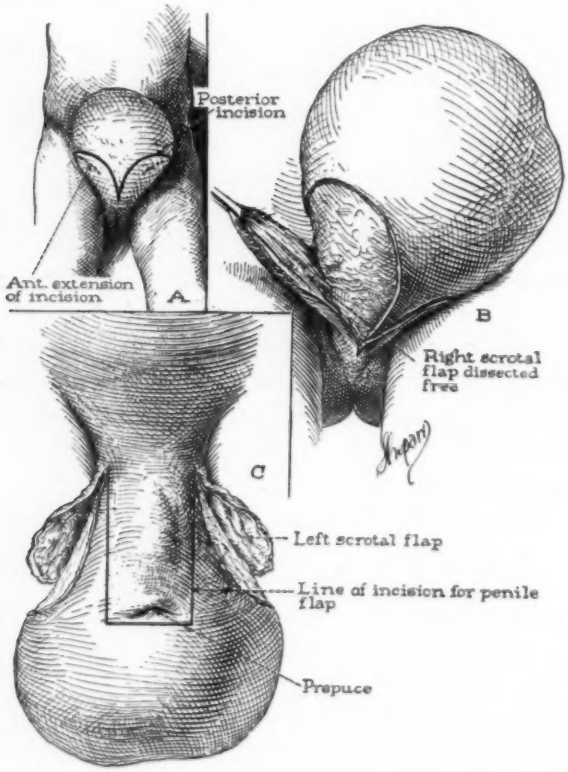

Fig. 1.

clamped and ligated and attention is then turned to the anterior aspect to the swelling. The slit which leads to the penis (the stretched-out prepuce) is taken as the guide to the lowest extent of the penile skin flaps in front. A transverse incision, starting 2 in. lateral to the slit and at a slightly lower level, is carried across to the same point on the opposite side (Fig. 1C). These incisions are then turned upward at right angles and terminate by joining the anterior extremities of the lateral scrotal flap incisions (Fig. 1C). The dissection of the anterior or penile flap starts below the slit and consists at first of a median cutaneous tube (Fig. 2A), the stretched-out prepuce, together with a lateral flap on each side. This is dissected upward and leads to the buried penis, which is dissected free together with the lateral flaps which are left attached to its dorsum. This maneuver is an important one as it avoids injury to the dorsal vessels. The penis and flaps are protected in warm saline sponges and retracted to one side. On each side of the

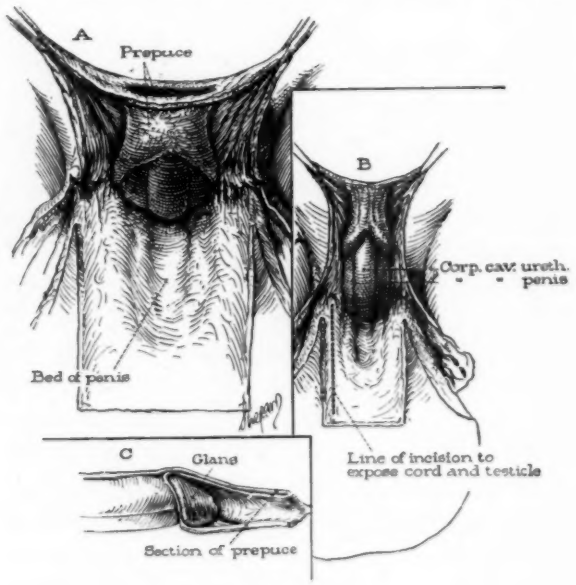

Fig. 2.

bed of the penis an incision 3 to 4 in. in length is made into the solid tissue of the growth to find the testicles (Fig. 2B). They are usually identified without much difficulty and are lifted upward, enabling one to dissect the corresponding cord up to the external ring (Fig. 3A).

If a hydrocele is present it is dealt with by excision of the most of the sac, followed by an eversion suture. The testicles and cords are placed at one side in warm saline packs. The remainder of the mass is now dissected rapidly from its attachment to the puboperineal region at what might be termed the pedicle. Many large vessels will be encountered on each side and are divided between double ligatures. The veins are left as long as possible before ligature, the arteries being dealt with first,

thus allowing as much blood as possible to return to the general circulation. The cord, which is usually considerably stretched, is partially shortened by a vertical gathering suture of catgut which is tied rather loosely. The cord may be further shortened by placing it around the testicle (Fig. 3B, C) and fastening it in place with at least two interrupted sutures of plain catgut. The preputial tube is inverted down over the penis (Fig. 3A, B). The penile and skin and the skin over the penis and upper sides of the tumor must be in a sufficiently healthy state to be utilized as skin flaps. Edema of the skin is not a contraindication to the use of the method but one could not employ this operation where the skin is grossly diseased.

CASE REPORT

G., native male, aged forty-five, presented himself at the Kanye Dispensary, Bechuana-

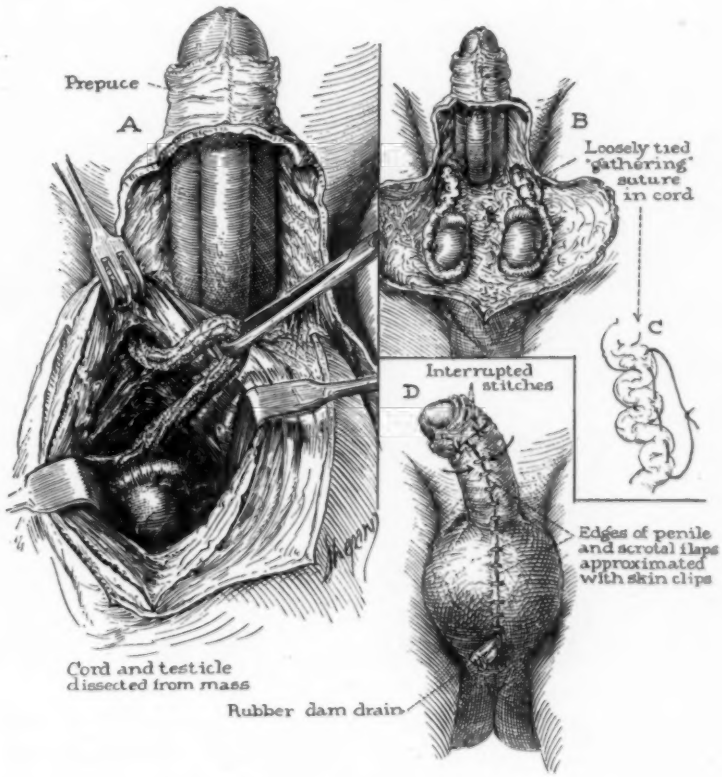

Fig. 3.

scrotal flaps are now brought together in the median line for the closure which is carried on from above downward (Fig. 3D), the subcutaneous tissues being united with interrupted catgut where possible and the skin with Michel's clips. A rubber tissue drain is inserted and carried out of the lower angle of the incision.

LIMITATIONS

It is recognized that this method is not applicable to every case but there is only one limitation to its use, viz., the preputial

land, South Africa, August 5, 1925. He had a large scrotal swelling (Fig. 4A). He stated that the trouble had started six years previously with swelling and pain in the left testicle, and further that the enlargement was rather rapid so that it soon involved the right side. He denied having a urethral discharge nor was a history of lues obtainable. He gave a history of pain and inflammation four or five times a year, and said that he had some difficulty in urination.

Examination (August 5, 1925) revealed a large scrotal swelling presenting a slit about midway down its anterior aspect. The swelling

was 14 in. in diameter. The glans penis was palpable a finger's length above the slit opening, on the anterior surface. The skin felt greatly thickened on the under surface, and toward the left side there were two small sinuses discharging pus. The right side of the mass felt firm and solid, while the left side was softer. No fluid thrill was obtainable and transillumination was negative. There were several enlarged groin glands on the right side but none on the left. The blood was negative for microfilariae on repeated examination. The urine was negative for sugar, albumin and pus.

Diagnosis: Elephantiasis scrotum.

Operation: August 23, 1925. Technique used as above described. The findings were interesting. A large hydrocele was found on the left side enclosed in a dense fibrous sac at least 3 in. thick. The testicle was found in the upper and posterior part of the sac. It was freed together with its cord, and the tunica was inverted and excised after the method of Winkelmann. On the right side at least 4 in. of fibrous tissue was incised and a cavity about 2 in. in diameter was opened into. This cavity contained foul pus which was evacuated. The testicle on this side was represented by a small knob of disintegrated tissues and was not dissected free. The mass was then excised and the wounds cleansed with hot normal saline and closed as previously described, using rubber tissue drainage. The mass weighed 13 lbs.

Postoperative Course. The temperature varied between 99° and 103.4°F. but returned to normal by the twelfth postoperative day. There was considerable oozing of blood during the first night. The clips were removed on the seventh day. There was a small skin slough at the junction of the penis and the new scrotum which healed by the nineteenth day. The rubber drain was removed on the ninth day. There was considerable serous discharge up to the sixteenth day. It was necessary to incise twice for small localized collections of pus. The patient left the hospital on the twenty-second day in good condition (Fig. 4B).

FIG. 4A.

FIG. 4B.

The patient was last seen September 10, 1926. His genitals seemed perfectly normal and on casual inspection it would have been impossible to tell that he had ever had an operation.

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PAIN AND MUSCULAR ATROPHY

TRACED TO ABNORMALITIES OF THE SPINE

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THE frequency with which the neurologist is called upon to aid in diagnosing the cause of unusual and vague pain without localized tenderness has made it necessary for him to study the remote pathology of this annoying condition. This has led to a thorough investigation of the condition of the spine in these cases.

The roentgenologist has met with frequent failure in his efforts to assist his colleagues in the diagnosis of these cases for the reason that his examination very often has covered the site of pain only. For instance, a patient is frequently sent to the roentgenologist for examination of his shoulder because of pain or muscular atrophy in that region. The shoulder is found to be perfectly normal, but if the roentgenologic examination is more extensive, covering the cervical spine, the real cause of the pain in the arm and shoulder is demonstrated. Therefore, with proper cooperation between the neurologist and

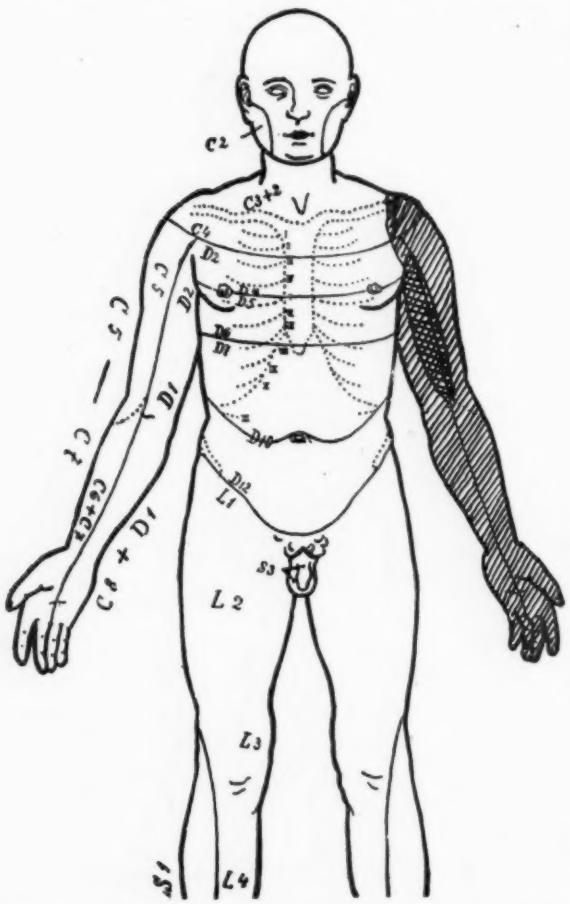

Fig. 1. Distribution of pain (light shading) and of atrophy (heavy shading) in Case 1.

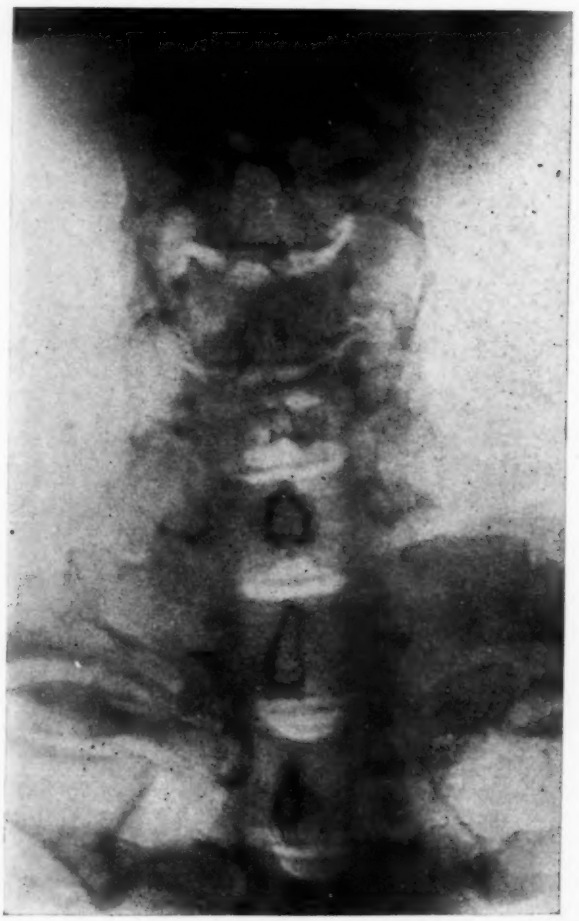

Fig. 2. Showing an old fracture of the fifth and sixth cervical vertebrae, with partial compression of the bodies on the left side in Case 1.

roentgenologist, a better understanding of these cases can be obtained and the reason for the distress located.

To illustrate our point of view we wish to report a few cases.

REPORT OF CASES

Case 1. J. A. M., white, aged forty-five, an executive, who twenty-five years before had sustained a comminuted fracture of the left elbow in a football game, complained of a severe scalding pain in the dorsum of the left arm and forearm for a period of seven years. Physicians consulted had invariably ascribed the pain to the fractured elbow. Questioning revealed that he had taken some strenuous chiropractic treatment one year prior to the onset of symptoms.

Six weeks before his visit to the Battle Creek Sanitarium, the patient had received a severe jar to the left arm which gave him complete relief from his symptoms for five weeks. At the end of this time he strained at an obstinate garage door and immediately all his old symptoms returned, much aggravated. At night he would lie for hours on the floor crying with pain, unable to sleep.

Examination did not demonstrate any tenderness whatever in the arm, but showed almost complete atrophy of the biceps and triceps, with a little atrophy of the muscles of the forearm. There were fibrillary twitchings and marked weakness of the arm muscles as well as spasm of the muscles of the neck. Pressing the head to the right relieved the pain, to the left produced it, but this the patient had never discovered.

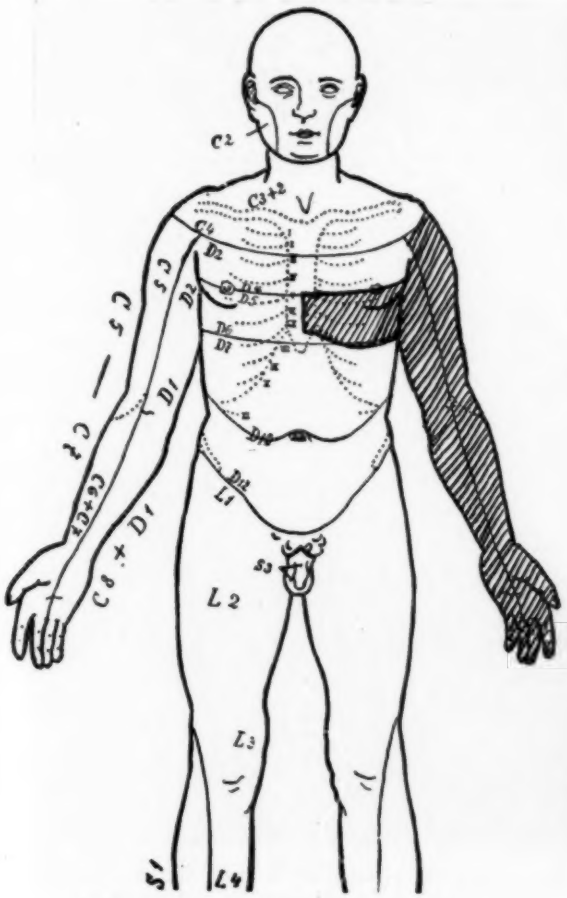

Fig. 3. Distribution of pain in Case II.

Fig. 4. Showing osteoarthritis involving the sixth and seventh cervical vertebrae in Case II.

As the muscles involved are innervated not by a single peripheral nerve but by the fifth, sixth, and seventh cervical roots, a roentgenogram of this region was requested. This disclosed an old fracture of the fifth and sixth cervical vertebrae, with partial collapse of the bodies on the left side (Figs. 1, 2). The consequence was a marked scoliosis. There were

also considerable formation of exostosis in the affected area and a compensatory scoliosis in the dorsal region.

The patient was given massage, hot and cold percussion douches and corrective manipulations to overcome the scoliosis, and was then fitted with a collar flanged to shoulder pieces. A brachial plexus neuritis developed under treatment and this was treated in turn. After five weeks the pain disappeared entirely and had not returned one year later. He wore the collar twelve hours a day for three months.

Case II. J. C. R., male, aged forty-six, who had been exposed much to weather and

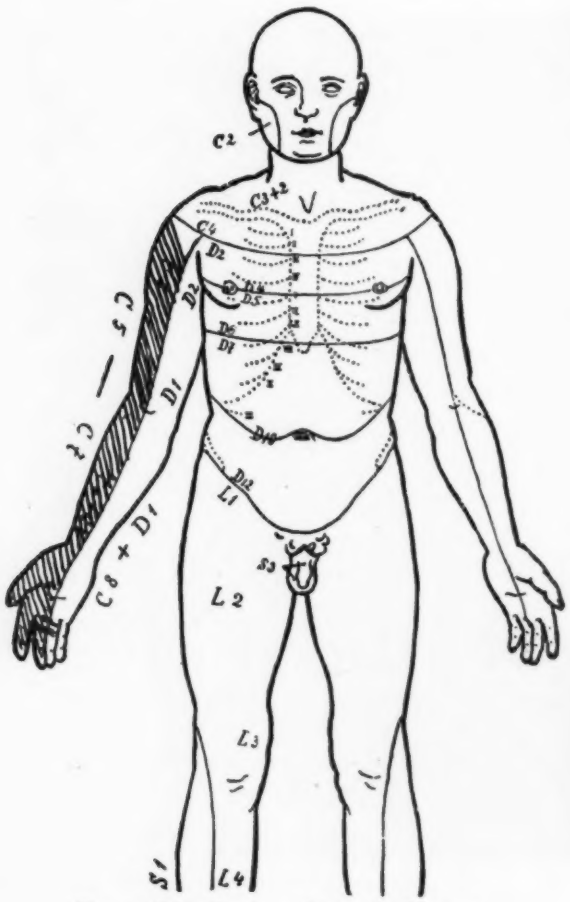

Fig. 5. Distribution of pain in Case III.

hardships for years, complained of pains of a year's duration about the left chest and in the left shoulder and arm. There was no tenderness whatever in the painful area. Manual pressure on the neck to the right relieved the pain somewhat, pressure to the left aggravated it.

A roentgenogram showed considerable lipping of the borders of the articular surfaces of some of the cervical vertebrae, particularly the sixth and seventh (Figs. 3, 4). There was also some lipping of the borders of the articular surfaces of the upper dorsal vertebrae, particularly the fifth, sixth, and seventh.

A tonsillectomy was done, after which the patient was treated for two months with heavy spinal massage and revulsive hydrotherapy to the cervicodorsal region. He was also given two courses of ten intravenous injections each of iodid, colchicum and salicylate. When the patient left he still had pain about the region of the heart, but was free from arm and shoulder pains. He stated he was 90 per cent relieved.

Fig. 6. Shows osteoarthritis involving the fourth and fifth cervical vertebrae in Case III.

Case III. W. A. R., a physician, aged fifty-two, complained of pain in the right index finger which in the course of some days spread "along the course of the radial nerve until it reached the shoulder." The entire arm had been painful for four months. The patient also had an emotional depression and multiple arthritis.

Physical examination gave us no help except to rule out neuritis as there was no tenderness along the course of any nerve. A roentgenogram of the cervical spine showed considerable roughening of the articular surfaces of the fourth and fifth cervical vertebrae, and there was some lessening of the intra-articular space (Figs. 5, 6), characteristic of osteoarthritis. The bones of the right hand were normal.

The patient was given gentle stretching of the neck, massage and revulsive hydrotherapy to the affected area. He continued this for two weeks but in a fit of agitation with depression he boarded a train and went home. His case could not be followed.

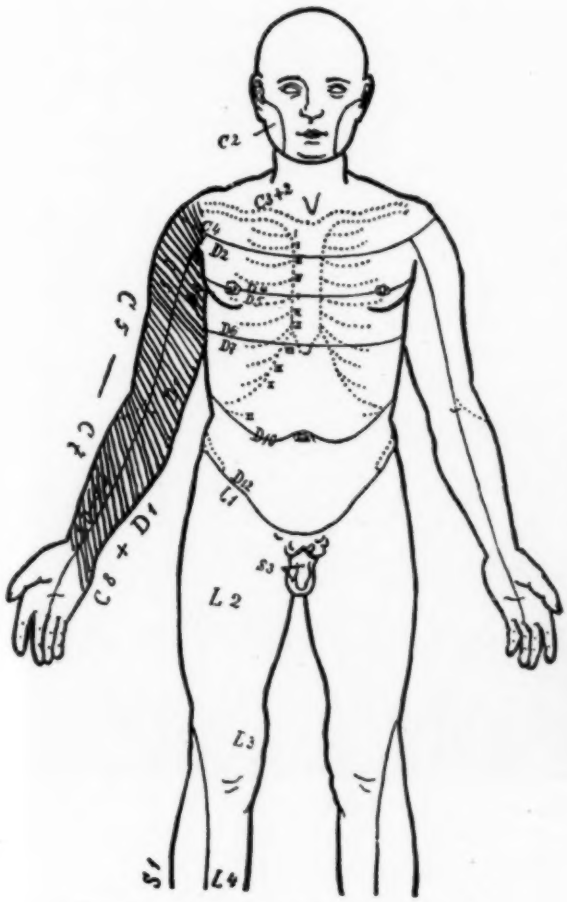

Fig. 7. Distribution of pain in Case IV.

Case IV. Mrs. M. D., aged forty-four, had suffered from "neuritis" of the right arm for years, during which time she had been attended by an osteopath. When the pains became incapacitating and no relief was obtained either day or night, one of us (J. M. N.), was asked to see her in neurological consultation. A great deal of tenderness was found in the region of the distribution of the pain and after an examination in the home a diagnosis of neuritis was made. The patient was advised to come to the institution for a thorough search for a focus of infection. After a week of futile examination, another and more careful physical examination was made and it was then discovered that while the patient had tenderness in the right arm she also had pain in the left and in the trunk and lower extremities. In fact she tolerated pain so poorly that a universal tenderness was present. A radicular cause of her "neuritis" was then suspected and a roentgenogram of the neck

Fig. 8. Showing osteoarthritis involving the sixth and seventh cervical vertebrae in Case IV.

made (Figs. 7, 8). This showed considerable roughening of the articular surfaces of the sixth and seventh cervical vertebrae, particularly the sixth, the bone changes being more pronounced on the right side. There was also a considerable lessening of the space between the sixth and seventh cervical vertebrae.

Massage to the neck and hot and cold percussion douches were then given and complete

relief obtained in less than four weeks. There has been no recurrence except slight twinges of pain of which the patient makes no complaint.

Case v. W. F. D., white, aged fifty, a railroad conductor who had been injured in a wreck twelve years before, complained of pain in the right hip joint, at times radiating down along the distribution of the right sciatic nerve. There was very little pain when reclining but the patient was unable to sit or stand because of the agony produced.

Six months before when the symptoms began he paid little attention to them. After three weeks he was forced to remain at home. He went to Hot Springs where he spent a month. After returning home her emained quiet a month and then had chiropractic treatments daily for another month. This seemed to relieve him at first but he soon developed so much pain that he was totally unable to work. There was no tenderness in the hip.

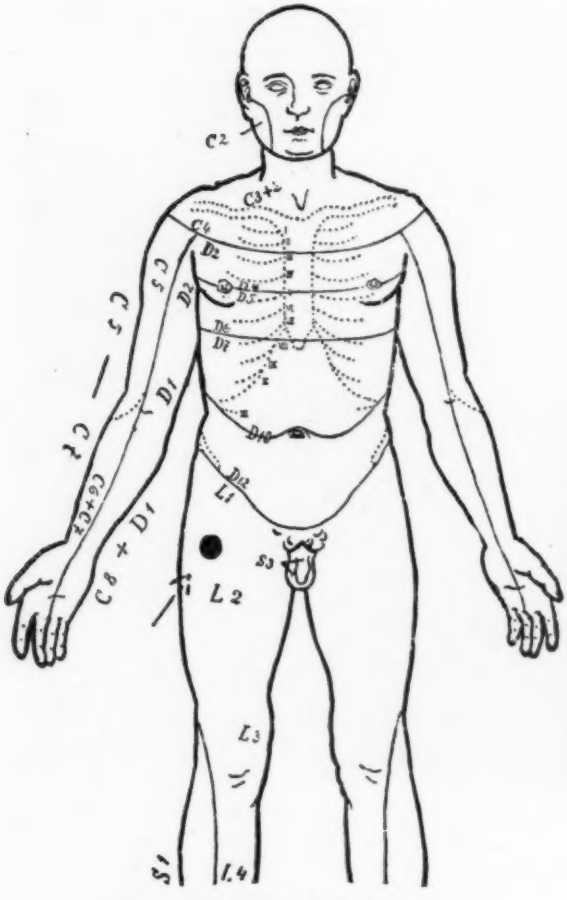

Fig. 9. Site of pain in Case v.

Examination confirmed the patient's statements. A roentgenogram of the lower spine showed an old fracture of the fifth lumbar and first sacral vertebrae, with collapse of the former (Figs. 9, 10). Strangely, the symptoms referred to the fourth lumbar segment but this was probably because pressure was greatest against that root. The patient was hospitalized for treatment in a cast.

Case vi. G. S., aged twenty-five, complained of weakness in his legs. Two years before he had been seized in play by a fellow workman, following which he had a little lameness in his back. Some months later he became weak as stated and this weakness progressed.

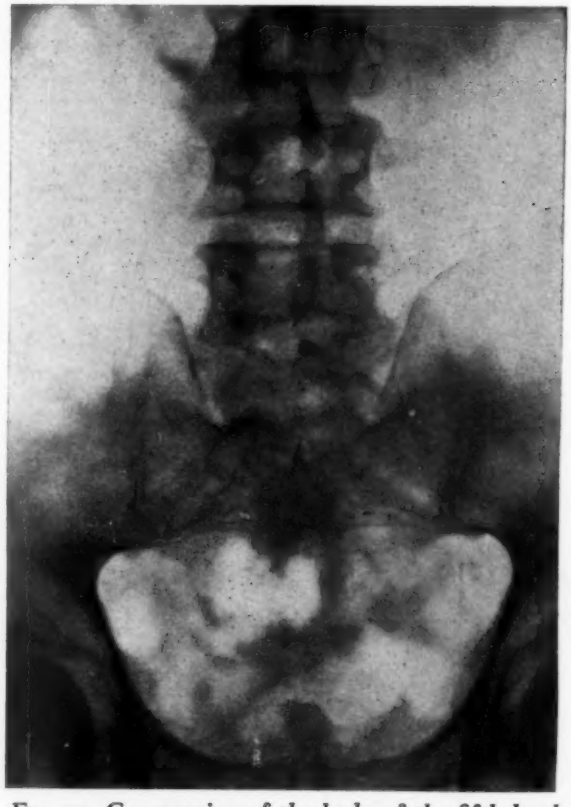

Fig. 10. Compression of the body of the fifth lumbar vertebra probably the result of an old fracture. Case v.

When examined he was found to have a sharp kyphosis in the upper lumbar region and unequal patellar reflexes, the right greater. Examination of the chest showed numerous medium and fine crackling râles in the upper third of both lungs. A roentgenogram of the lungs showed closely set flocculent shadows in

the same areas. Tubercle bacilli were found in the sputum.

A roentgenogram of the spine revealed some compression of the bodies of the first and second lumbar vertebrae with considerable increased bone density (Figs. 11, 12), which was more pronounced in the body of the second lumbar vertebra. The condition was characteristic of an old injury resulting in a compression of the bodies and some scoliosis with convexity to the left. The sacrum and right hip were normal. It was clearly a case of pulmonary tuberculosis with tuberculous spondylitis. The injury probably merely served to localize the lesion where the kyphosis later occurred.

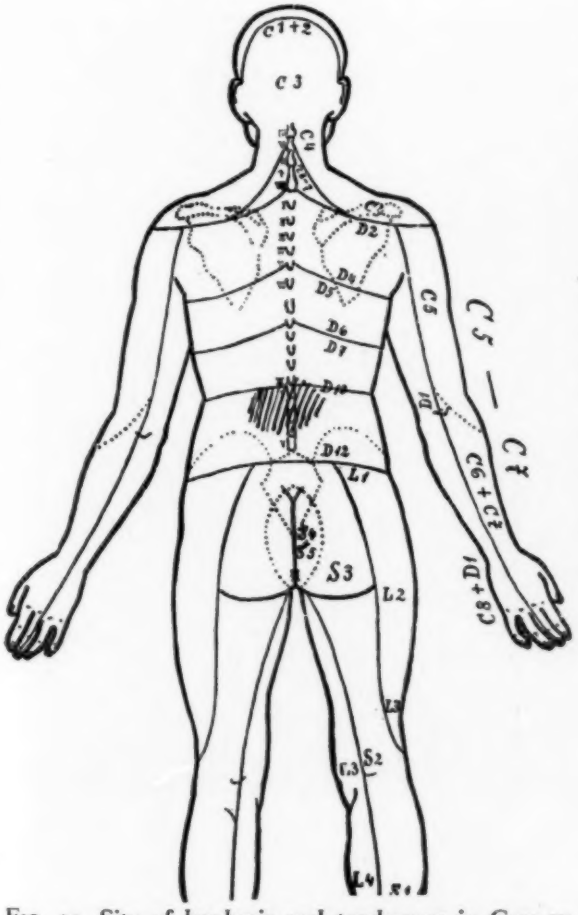

Fig. 11. Site of kyphosis and tenderness in Case vi.

Case vii. G. W., male, aged sixty-six, came complaining of severe pains about the chest and in his spine. He had not been able to sleep on his side for ten years but had never admitted to his family that he suffered. In walking upstairs he had often been observed to wince and show other signs of pain. There was no tenderness about the chest where pain occurred.

Examination confirmed the absence of tenderness but the spine was found to be practically immobile. Roentgenologic study revealed an extensive roughening of the articular surfaces and a marked lipping of the borders of the lower dorsal and upper lumbar vertebrae. The bodies of some of the vertebrae showed partial destruction, particularly the seventh, eighth, and eleventh dorsal (Figs. 13, 14). The condition was characteristic of a high grade of osteoarthritis.

The patient was given careful stretching, massage and hot and cold percussion douches to the spinal region. After four days he enjoyed a night's sleep without pain and improved

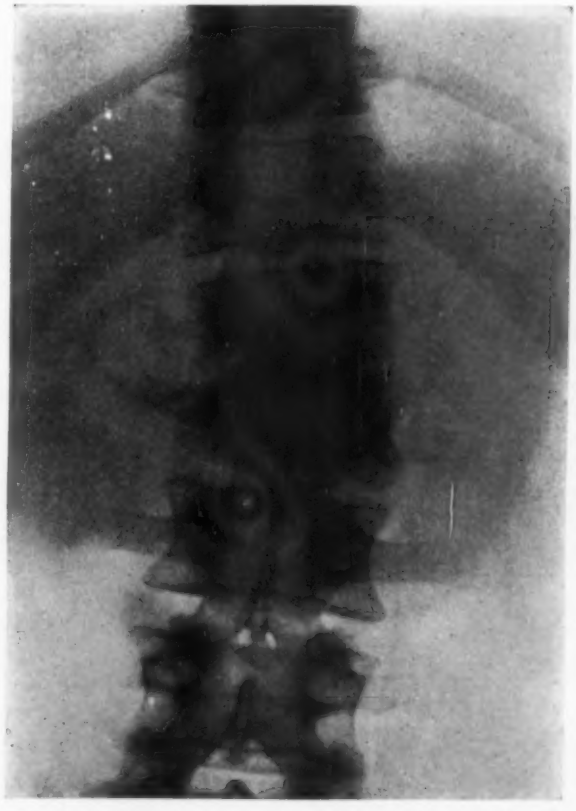

Fig. 12. Shows compression of the bodies of the first and second lumbar vertebrae with considerable increased bone density. Case vi.

steadily for a month. He chose to remain at home for two days. When we again saw him he said he had not appeared because of a cold. His temperature was 104°F., pulse 130. He had bronchopneumonia and died of this four days later.

Case viii. W. H. B., male, aged forty-six, undertook treatment because of an alcoholic

psychosis. He had so many delusions that no attention was paid to a complaint of pain in the right hip, which continued for five weeks during the early part of his stay with us. This pain occurred only on walking; he was entirely free when resting.

When his psychosis had partly cleared and we could obtain cooperation in our research, the area was carefully reexamined. There was no tenderness whatever in the right hip or leg but a sensitive area was found at the fifth lumbar vertebra. A roentgen-ray study of the lower spine showed definite bone changes. The fourth lumbar was displaced forward on the fifth about 2 cm., and there was some destruction of the upper surface of the fifth (Figs. 15, 16). There was also increased density of the bone around the superior and inferior articular processes. The appearance was typical of spondylolisthesis, probably the result of an old injury.

Surgery was recommended but refused. The patient left for home to be treated further by his local physician who thought he might obtain surgery later.

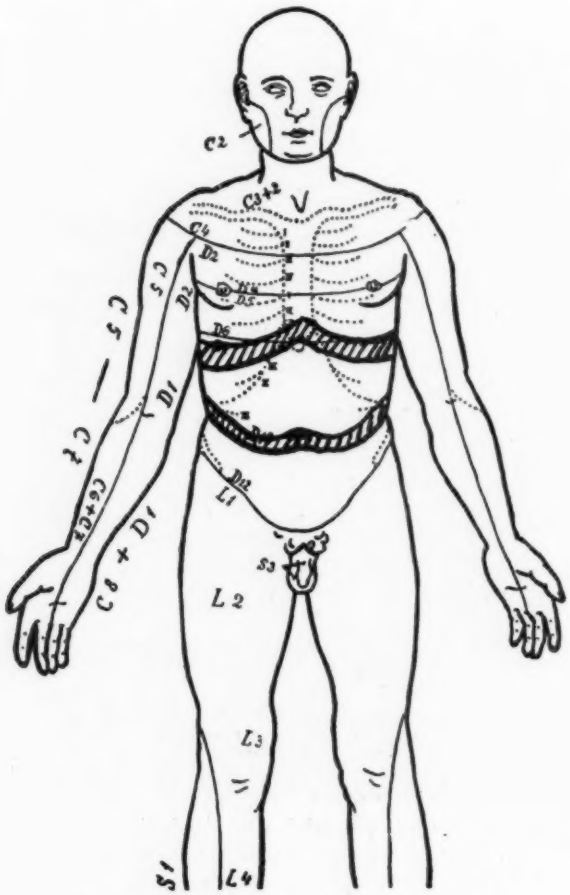

Fig. 13. Distribution of pain in Case vii.

It is not our purpose to distract from the well-established principles of medicine and present a new etiology for all pain, but rather to present the spinal etiology of obscure pain in its true light. For that reason we are recording the two following cases as a warning to be cautious.

Case ix. Mrs. E. S., aged fifty-two, had been suffering for fifteen years with pain in the right arm and shoulder. There never had been any tenderness in the afflicted area. She had consulted regular practitioners for years without results and then took osteopathic treatments with temporary relief. She next came under our observation.

Fig. 14. Shows a high grade of osteoarthritis of the dorsal vertebrae with a partial destruction of some of the bodies, particularly the seventh, eighth, and eleventh as indicated by arrows. Case vii.

A roentgenogram showed osteoarthritis of the seventh cervical vertebra (Figs. 17, 18).

A diagnosis of radicular irritation was made. The usual treatment gave complete relief in five weeks so that the patient was comfortable if she took considerable exercise and did not exposed herself to cold or damp weather. But this relief lasted only about six months when the old symptoms returned. At this juncture the case was restudied and referred to a medical consultant. In spite of previous careful examination of the sinuses and negative roentgenograms, the consultant insisted on a lipiodol study of the sinuses. Several drams of pus were found. When the sinuses had been cleared up, no recurrence of the symptoms was encountered.

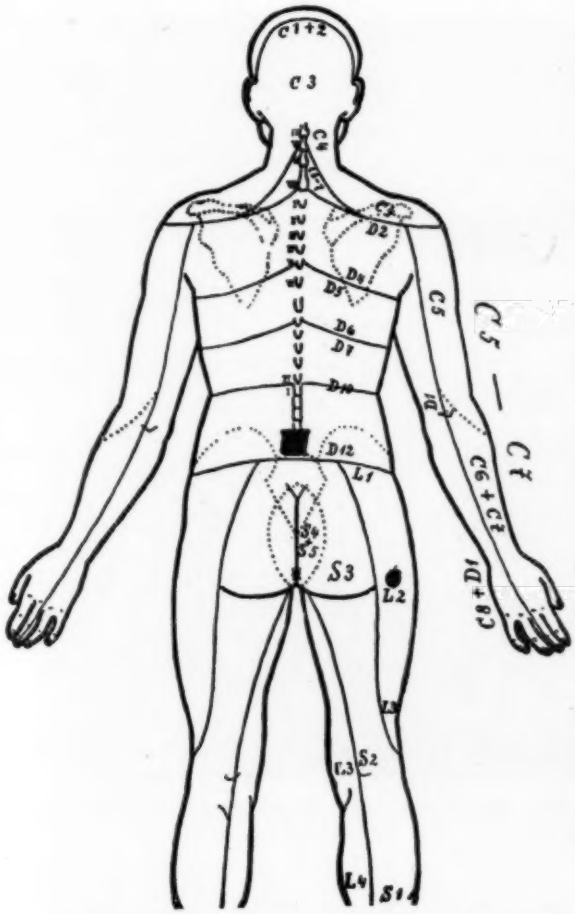

Fig. 15. Area of tenderness in the spine and pain without tenderness in the hip joint in Case VIII.

Case X. Mrs. M. M., aged fifty-five, suffered from sudden lancinating pains in the region of the right deltoid insertion. After four days of terrific pain, she "lost consciousness and was delirious for three weeks." When she regained consciousness the pain was much relieved but was still present. She came to us for study and treatment.

Because the pain rapidly disappeared, we investigated the period of unconsciousness more carefully than we did the pain. Hatred of the husband was soon evident, based on a parentally forced marriage and brutal treatment by the husband over a period of years. A diagnosis of hysteria was made and the patient left after four weeks, apparently well.

In two weeks she returned, again complaining of the pain which had now spread to the outer side of the entire arm. A roentgenogram showed a normal shoulder, but with prominent lateral processes on the seventh cervical

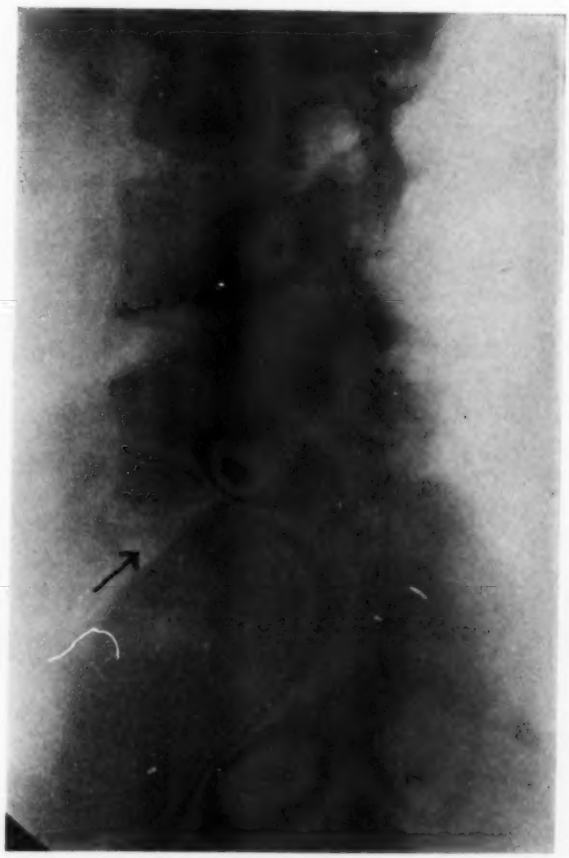

Fig. 16. Showing the body of the fourth lumbar displaced forward on the fifth about 2 cm., with some destruction of the upper surface of the fifth. Case VIII.

vertebra and signs of a mild arthritis (Figs. 19, 20). By this time there had been developed a marked limitation of motion of the shoulder joint which was entirely relieved by pressure over the deltoid insertion. A diagnosis of bursitis was made and treatment directed to this condition. Ankylosis of the shoulder joint

was looked for but was not present. Following the extraction of four infected teeth, there was a terrific flare-up of pain in the entire right arm which did not subside for ten days.

During this time the patient was of necessity kept quiet and when she was again able to be up another examination revealed complete fixation of the shoulder joint. This complication was treated in turn by radiant heat, diathermy, hydrotherapy and massage. The spine was similarly treated, and in three weeks about 60 per cent mobility was obtained. This was improving rapidly when the patient left, practically well.

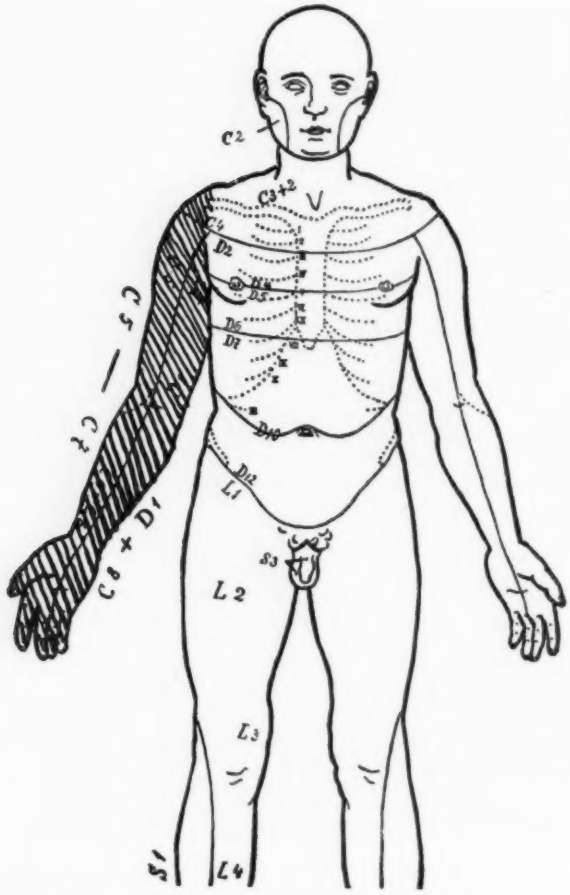

Fig. 17. Distribution of pain in Case ix.

These two cases serve to emphasize that

1. All pain is not necessarily due to an arthritis even when this is present.

2. Two or three concomitant diseases may occur.

3. The focus of infection which is the original cause of the arthritis should be found and removed if possible.

COMMENT

In referred pain the neurologist should be of considerable aid in the localization of pathology by tracing skin areas or individually involved muscles to the corresponding segment of the spinal cord, thus suggesting the segment of the spinal column in which the pathology of referred pain should be found. Unless there is shown a definite relation between spinal column pathology and the site of pain, an arthritis of the column must not be assumed to be the cause of the pain. Even when the association mentioned definitely exists, mistakes are possible. Because of this, the neurologist collaborates with the radiologist, the former stating where the spinal column pathology must be (if it is the cause of the pain), the latter inde-

Fig. 18. Osteoarthritis involving the seventh cervical vertebra in Case ix.

pendently stating where the pathology (if any) actually occurs.

Atrophy or fibrillary twitching of muscles is often a good guide to the spinal lesion. Pain alone is less reliable but objective changes in the skin sensibility are of extreme importance.

SUMMARY

1. A series of cases has been presented to demonstrate the value of roentgenography in the diagnosis of the cause of referred pain.

2. Cooperation between roentgenologist and neurologist is necessary for the accurate determination of the causal relationship between spinal column lesions and referred pain.

3. Neuritis, neuralgia and toxic effects of infection must be carefully considered in arriving at a diagnosis.

4. The radicular cause of pain is far more common than usually suspected.

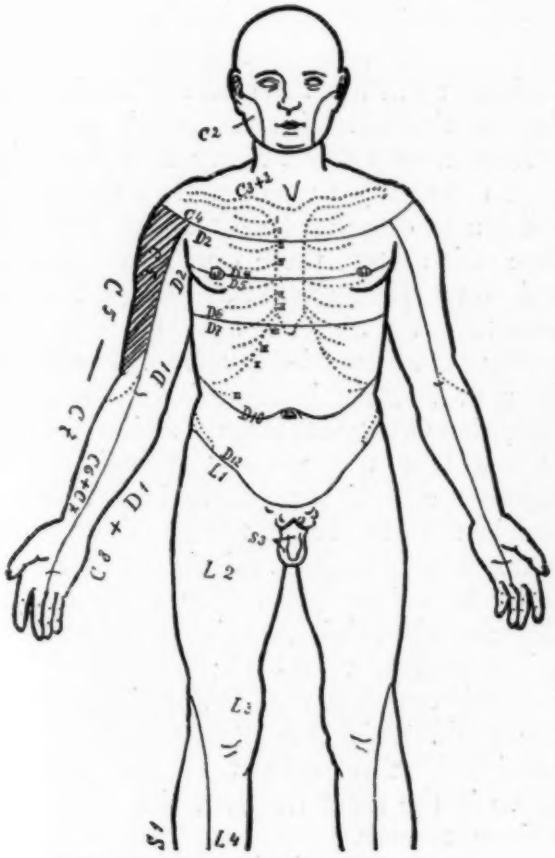

Fig. 19. Distribution of pain in Case x.

Fig. 20. Note prominent lateral processes on the seventh cervical vertebra and signs of a mild osteoarthritis. Case x.

CIRCUMSCRIBED FALSE PERIPHERAL NEUROMATA

REPORT OF TWO CASES

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THIS communication deals with solitary tumors of peripheral nerves, of a type usually described as false neuromata, neurofibromata, or neurofibromyxomata. Though this type of tumor sometimes undergoes malignant change, the cases we discuss fall under the class considered benign. The malignant tumors of this group are of the sarcoma type. The differentiation between a benign false neuroma and one which has undergone malignant change is apparently not easy to make.

The term neuroma should be reserved for true nerve tissue tumors with ganglion cells present, containing nerve fibers, sometimes medullated. A. Thompson[1] in 1900 said that there were only five authenticated cases on record. They are innocent, usually originating from the abdominal sympathetic nerves, sometimes in the subcutaneous tissue, and are to be differentiated from neurofibromatosis.

The solitary, circumscribed false neuroma is usually fusiform, arising from the nerve sheath. A tumor large enough to attract attention may spread out the nerve fibers, though rarely the nerve fibrils pass through the tumor. The long axis of the fusiform tumor coincides with the long axis of the nerve to which it is attached. The tumor is usually smooth, rounded, encapsulated, movable laterally but not up and down, and tends to undergo myxomatous degeneration, which later on, especially in the larger tumors, may result in the formation of cysts, single or multilocular. These false neuromata vary greatly in size; Kerr[2] described what he thought to be the largest fibroma on record, a pure fibrous tumor arising from the sciatic nerve, weighing 1 pound, 3 ounces and measuring 6 by 3 inches. They are rare, circumscribed, and occur in the course of a nerve which presents no other pathological change.

It is believed that the sarcomatous tumors of this group are not primarily malignant but are the result of malignant degeneration of benign tumefactions.

They may occur at any age, but are most commonly encountered in the third and fourth decades. In fifteen cases where the sex is stated, there were eleven males and four females. The youngest was seventeen, the oldest was eighty.

Any nerve may be involved. The most frequent location is the sciatic nerve. In analyzing twenty-six cases of solitary nerve tumors (the two we are reporting and twenty-four which we have been able to find in the literature), the location of the tumor was as follows: sciatic nerve, seven cases; brachial plexus, five; ulnar nerve, three; median, tibial, cervical and musculospiral nerves, two each; and popliteal, internal cutaneous and anterior crural, one each. This is contrary to previous published statements that the median nerve is the most frequent site of benign solitary tumors.

Flatau and Sawicki[3] have reported a very interesting case of an enormous neurofibroma found at autopsy, the tumor involving the second and third cervical nerves. They also cite cases reported by Dowse,[4] Heurteaux,[5] Zinn and Koch,[6] Boerner,[7] and Bing and Bircher,[8] all of which were instances of neurofibromatous type of tumor of intraspinal origin as was probably also the case reported by Flatau and Sawicki.

In general they are very likely to be

sensitive, although some cases are recorded where the lack of sensitiveness led to failure to make a correct preoperative diagnosis. There is rarely any loss of motor or sensory power of the nerve involved in an innocent nerve tumor; even in the most severe cases the symptoms are variable, usually

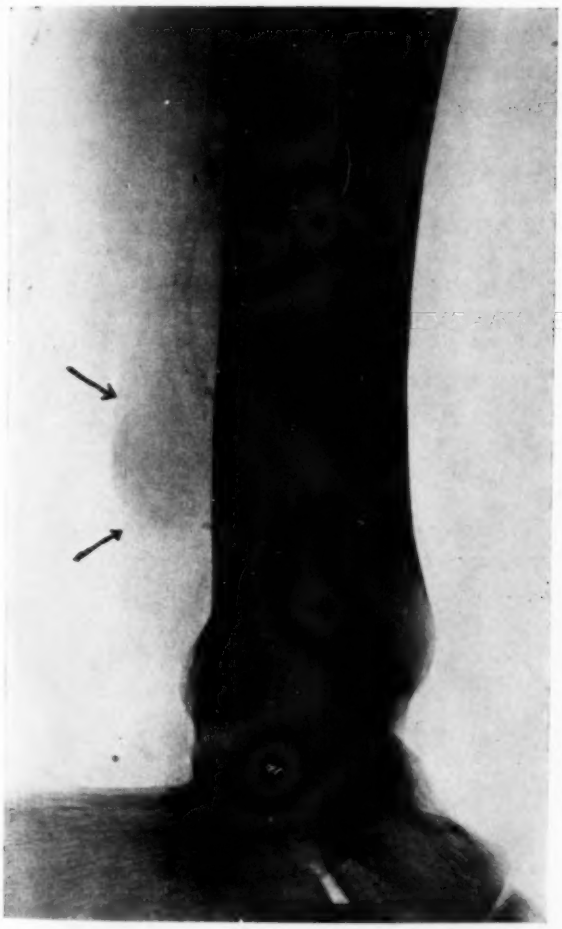

Fig. 1. Roentgenogram of left leg showing normal bony structure, and a soft tissue tumor (at arrows) between bones and Achilles tendon, the tumor causing definite local displacement of calcareous posterior tibial artery.

consisting of tingling and "pins and needles" sensation along the sensory distribution of the nerve.

The etiology is not well known. Trauma is usually considered as the chief factor in the production of discrete neuromata and yet a history of definite injury over the member, the site of the neuroma, is not often obtainable. However, it is a fact that these circumscribed tumors are usually located in some exposed position, easily and frequently subjected to repeated trauma of a relatively mild nature not sufficiently painful to attract one's attention. The two cases reported by Fleming and Marvin[9] both gave a definite history of injury. These were both large tumors of

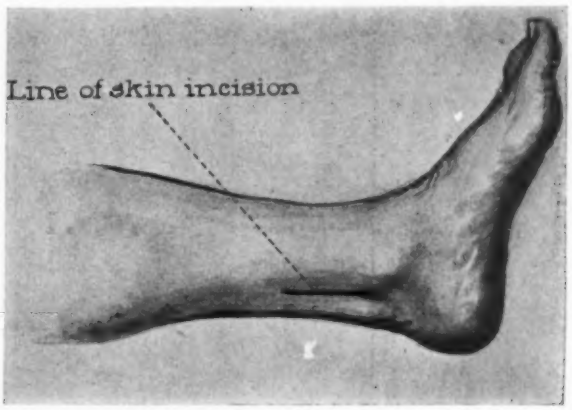

Fig. 2. Line of incision for enucleation of tumor of posterior tibial nerve, just above malleolus.

the sciatic nerve, almost the size of a man's fist. Fleming and Marvin also brought out the striking fact in their cases that the patients were brother and sister. Their report is the first to suggest the existence of a hereditary tendency toward the formation of discrete false neuromata.

Benign nerve tumors grow very slowly. In most cases the patient has been aware of the tumor for years. Sometimes a tumor will exist for a long period without any apparent change in size and then undergo sudden and rapid enlargement. In other cases the growth is very gradual over a period of years. In Gatch's[10] first case, the tumor exhibited gradual growth during eleven years until it reached the size of an English walnut and then in one year attained the size of a hen's egg.

Since these tumors may undergo malignant degeneration, there seems to be a real danger in postponing operation indefinitely, especially when they are associated with sensory or motor nerve disturbances. In favor of a benign growth are absence of motor or sensory paralysis and long dura-

tion. Gatch's first case, as well as Linell's[11] and several others, demonstrate that even sudden and rapid growth in a tumor which has existed for years without enlargement, does not constitute positive proof of malignant change. In several cases, including one of ours, the pain was extraordinarily distressing; yet nothing in the gross or microscopic appearance of the tumor suggested malignancy. Even at operation it may be very difficult to determine the innocence or malignancy of one of these growths.

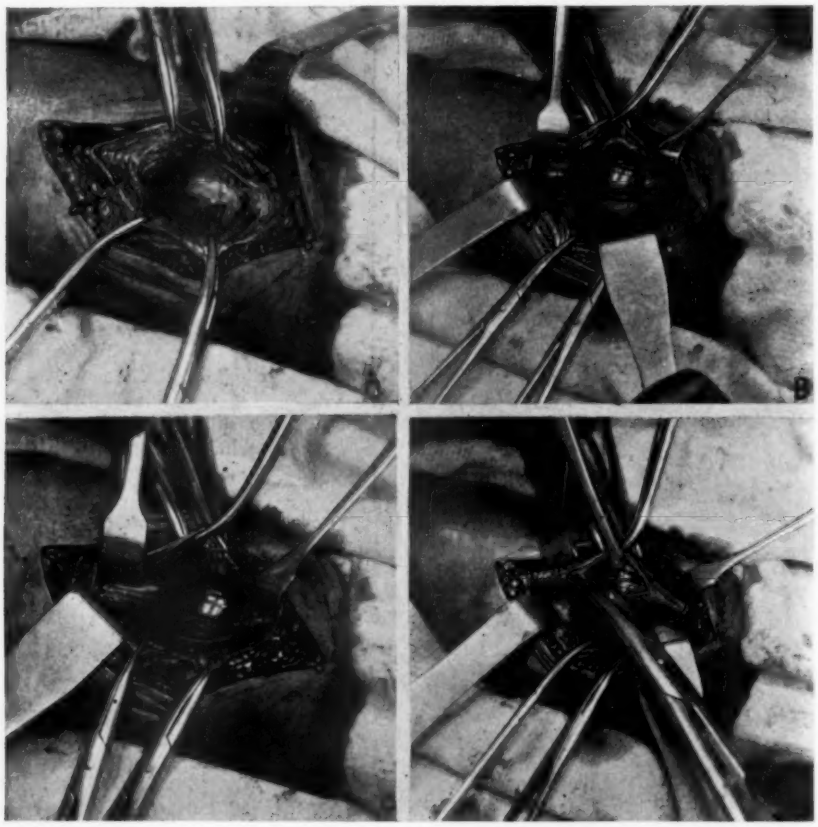

Fig. 3. Illustrating various stages of enucleation of a tumor of the posterior tibial nerve.

MacArthur[12] has published an interesting case of sarcoma of the posterior tibial nerve in which from the history the tentative diagnosis was a benign neuroma. At operation it was found that the tumor terminated above and below in a polar elongation. The nerve trunk was obliterated in the tumor substance. MacArthur resected the nerve trunk with the tumor. Later, there was found a large inguinal mass which on removal proved to be a sarcoma of the lymph glands.

If the tumor is encapsulated and easily shelled from the center of the nerve trunk, the probability of a benign growth is indicated. On the other hand diffusion of the tumor without encapsulation and fixation to the neighboring tissues strongly suggests sarcoma. A detailed study of the reported cases indicates that the microscopic study of the tumor should not be relied upon to the exclusion of other evidence. The conclusion is warranted that if the surgeon is in doubt as to the nature of a solitary tumor of a peripheral nerve he should treat the lesion conservatively, especially if its removal involves the possibility of permanent impairment of motor function. In most benign tumors one can enucleate the tumor, preserving the nerve fibers with very slight permanent

impairment of the nerve and very slight probability of recurrence following such a conservative procedure.

Case 1. Mr. R. W. (103–161), aged eighty, was referred May 28, 1916, by Dr. C. C. Hubly for treatment of a small tumor on the left arm. There was no history of trauma or disease of the left arm or shoulder or of the cervical vertebrae. The patient was not aware of a similar growth in any member of his family. He consulted us simply because for years he had noted a small movable tumor on the outer side of the left arm, 4 or 5 cm. above the elbow, and because pressure over the tumor caused pain radiating down the arm. There were no enlarged axillary glands and no pulsation over the tumor. Mobility was free laterally but not up and down. There was no subjective pain except when by accident the tumor was compressed, and no motor or sensory disturbances in the forearm or wrist. Since the tumor was movable, it was not thought necessary to make a roentgenogram. The patient was subject to varicosities of both legs and even in the arms the superficial veins were very large. The tentative diagnosis was an old hematoma, lipoma or some other benign connective tissue tumor, or a possible neuroma of the musculospiral nerve.

Operation, June 1, 1916 (J. T. C.), under local anesthesia. Incision 7 cm. in length on the outer side of the humerus, parallel to the brachialis anticus muscle. On exposing the musculospiral nerve, it was found to be the seat of a fusiform swelling tapering off into normal nerve above and below the tumor, the nerve fibers spreading out around the mass. After opening the nerve sheath by a longitudinal incision, the nerve fibers were carefully lifted aside with practically no injury to the nerve, and the mass enucleated without difficulty. The incision in the nerve sheath was approximated by one or two fine sutures of plain catgut and the wound closed in two layers with absorbable suture. Healing *per primam*. There was no subsequent distress of any consequence and no motor disturbance.

The patient visited the institution on several

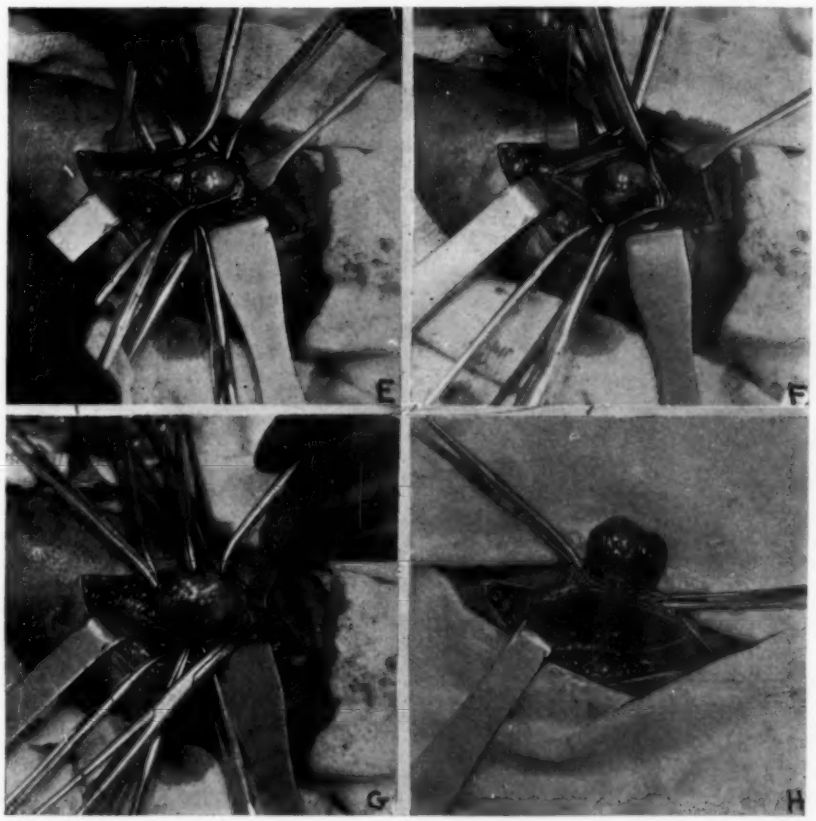

Fig. 4. Illustrating further stages of enucleation of tumor of posterior tibial nerve.

later occasions for the treatment of pernicious anemia, of which he finally died at the age of eighty-six.

The pathologist said the tumor exhibited a loose cellular structure containing a large number of lymph spaces. Microscopically the neoplasm consisted largely of dilated lymphatics apparently in nerve bundles which were more or less typical. The growth was classified as a lymphangioneuroma.

Fig. 5. Photograph of enucleated tumor.

Case II. Mr. A. P. (199–077) aged sixty-three, locomotive inspector, was admitted August 8, 1927, for relief of nervousness, insomnia, constipation, and especially for treatment of neuritis involving the left leg and foot. During the past fifteen years the patient had suffered from neuritis of the left ankle and foot with some remissions but never complete relief. The foot was very sensitive to changes in the weather. On the left leg just above the ankle, more evident on the internal aspect of the member, was a rounded swelling about 2 cm. in diameter, somewhat movable laterally but not in the longitudinal axis of the leg. It was not attached to the skin. Neither was it sensitive to gentle pressure, but pinching or hard pressure caused intense pain shooting into the foot. The pain was described as a burning, especially in the sole of the foot. No pulsation could be detected in the tumor and there were no large inguinal glands.

The lump was first noticed about twenty years before admission and was much smaller then than it is now. His attention was called to it by pain in that region, the distress being increased by pressure. He had always suffered a varying degree of pain in the left ankle and foot, involving particularly the middle third of the sole of the foot. About twelve years ago the symptoms increased in severity and the lump began to enlarge. Lately the local condition seemed to influence his general nervous state, aggravating it considerably. Although several physicians had advised him to pay no attention to the lump and its attendant symptoms, the patient was convinced that it had been the real cause of his nervousness and general neurasthenic state. There was a distinct limp when walking. The blood Wassermann test gave a negative reaction.

Roentgen-ray study (Fig. 1) failed to reveal any abnormality of the bones of the leg or ankle, but it did show distinctly the presence of a tumor between the shadow cast by the Achilles tendon and the bones of the leg, causing a distinct local displacement of the neighboring calcareous artery, this shadow corresponding definitely to the palpable painful tumor.

Tentative diagnosis: Neuroma of the posterior tibial nerve.

Operation, August 18, 1927 (J. T. C.), under local anesthesia. The posterior tibial nerve was exposed through a longitudinal incision on the inner side of the left leg just above the ankle (Fig. 2). It was found to surround a well-encapsulated, fusiform tumor about 3 cm. in diameter (Fig. 3, A, B, C). The nerve was of apparently normal structure above and below the tumor. The sheath of the nerve was split longitudinally (Fig. 3, D), and the fibers spread to one side or the other, as seemed most convenient and most likely to produce a minimum of traumatism, until the tumor itself was exposed and enucleated (Fig. 4, G, H). It was necessary to inject some novocain into the nerve itself before proceeding with the enucleation of the mass, which was seen to grow from the sheath of the nerve on its anterior external aspect. The tumor measured 2 cm. in diameter. The sheath was then lightly sutured with three plain No. 00 catgut sutures and the wound closed. Immediately at the termination of the operation, twenty-five minutes after the injection of novocain into the nerve itself, the patient was able to perform all

normal movements of the foot and toes in all directions. For several days there was great subjective pain just as before the operation but somewhat exaggerated. Radiant heat and diathermy afforded the most marked relief. Convalescence was greatly retarded by the patient's exceedingly nervous and despondent state. However, a letter from him, dated April 1, 1928, makes it clear that he has almost completely recovered normal sensory function in the affected ankle and foot.

The pathologist's report on the tumor follows: The tissue shows nearly a pure neuroma in areas; other areas show neuoglia. No ganglion cells found, although there are atypical neuroblasts. Nerve fibers are chiefly nonmedullated. Throughout the tumor there are large and atypical lymphatics and blood vessels. Some blood vessels show some hyaline change in the walls, cylindromatous change. There are also areas of myxomatous tissue scattered throughout the growth and some pigmented areas from old hemorrhage. The general structure is that of a congenital disturbance of development resembling the cirsoid neuroangioma.

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TONSILLECTOMY

UNDER LOCAL ANESTHESIA

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BATTLE CREEK, MICHIGAN

THE tonsil operation technique adopted in the clinic at the Battle Creek Sanitarium exemplifies the best points from the work of such men as Matthews of Rochester, Canfield of Ann Arbor, Boot of Chicago, Fisher of Cleveland and King of New York. The plan of operation which appealed most to us after careful observation of the work of these and other surgeons was removal with a wire snare following careful dissection of the tonsil close to the so-called capsule. This is still the method of choice in our clinic (Fig. 1).

As a preliminary to each operation a blood coagulation test is made. One of our most distressing experiences came a number of years ago before this test was introduced. At that time inquiry was, however, made about each patient's tendency or history as to bleeding. A physician who had marked arthritis and obviously diseased tonsils was brought for operation by a member of our staff. Neither physician mentioned any bleeding tendency and, being himself a physician, the patient was asked no questions. At operation and for three or four hours afterward, he bled quite alarmingly. Later he stated that a few weeks previous he had had a severe hemorrhage from or into his urinary bladder.

The possibility of a change in coagulation time or bleeding time is illustrated by a case in the practice of a colleague. A patient desired a plastic operation on the skin below her chin. This surgeon had performed two major operations on her within two years preceding without troublesome bleeding. Following the plastic operation the surgeon and his associate spent six or seven hours applying digital pressure over sponges along the line of incision to stop persistent capillary oozing. The coagulation time when tested the next day was forty-five minutes.

Routinely morphine sulphate $\frac{1}{8}$ grain with atropin sulphate $\frac{1}{150}$ grain is given hypodermically about thirty minutes before the patient enters the operating room (Fig. 2). In any case in which there is contraindication to opium alkaloids the atropin alone is given. When indicated by the nervous instability of the patient, a more profound effect is induced by H.M.C. tablets No. 2 containing hyoscine hydrobromide $\frac{1}{200}$ grain, morphine hydrobromide $\frac{1}{8}$ grain, cactoid $\frac{1}{120}$ grain, or by double that dose as contained in the H.M.C. tablet No. 1.

No cocaine is used either topically or by infiltration. A 1 per cent solution of novocain is used, slightly colored with methylene blue. The three fatal cases under local anesthesia preparatory to tonsillectomy that have come to our attention have all been due to a mistake in the solution percentage, either in the drug room or in the preparation room. One of these fatalities occurred at a military hospital, one in a university clinic and one in a physician's office. Either $\frac{1}{10}$ of 1 per cent or 1 per cent solution of cocaine was intended, and 10 per cent solution was used. In our clinic 1 per cent cocaine was used unintentionally in one case instead of 1 per cent novocain. Immediate discovery of the substitution and prompt removal of the tonsil with escape of a large amount of the infiltrate prevented unfortunate results. Following this the surgical nurse proposed a color identification of the solution to be used for infiltration. The pharmacist suggested a trial of methylene blue. This has

been very satisfactory, not only as an insurance but as an indicator. The color contrast between the blue infiltrate and the pink tissues shows very clearly where and to what degree the anesthesia has been extended. Into one ounce of the 1 per cent solution of novocain are dropped 5 minims of epinephrin. Usually more than

Fig. 1. Instrument table with solutions and supplies.

one-half and less than three-quarters of the ounce is used on the two sides.

Besides the above experience with 1 per cent cocaine in place of 1 per cent novocain, we have had only one other unfortunate occurrence. We have in stock a large bottle of sterile saturate solution of sodium chloride. From this the pharmacy prepares easily and as needed the normal saline solution which is the solvent for various medicaments. On this occasion the full strength mother solution of saline was used instead of the diluted normal saline solution. This solution was used for one patient by one surgeon, and by a second surgeon in one case for both tonsils and in another case for one tonsil. The patients complained of pain at the time of injection, the tissues turned at once a peculiar purple color, and later there was superficial sloughing of the tissue overlying the muscles of the fossae. No secondary hemorrhage ensued, however, and the final appearance of the faucial pillars was quite good. We considered ourselves fortunate not to have injected the solution intramuscularly.

A small superficial area of infiltration is made in the submucosa of the anterior and posterior pillars (Fig. 3). This insures surface anesthesia. Then about one-half a dram of solution is introduced deeply into each of three sites. The first is through the loose membrane covering the supratonsillar fossa so as to fill the space above and behind the head of the tonsil. The

Fig. 2. Patient in operating chair showing overhead ring to carry light cord behind operator in all positions.

second is downward and inward just in front of the posterior pillar near the lower pole. The third is downward and backward through the plica triangularis just anterior and below the tonsil. From three to five minutes delay before operating insures hemostasis and anesthesia.

The primary incision is a small nick or puncture within the triangular loose membrane high between the pillars and just over the front edge of the tonsil crown or head (Fig. 4). This is a dry wound, and exposes the glistening outer surface of

the tonsil head. By this exposure the postoperative relation of the pillars above is insured and a proper approach for the following dissection made easy. In making this nick the tonsil is tugged a bit downward and toward the midline of the throat. This makes the triangle of approach quite evident and tenses the mucosa to the knife.

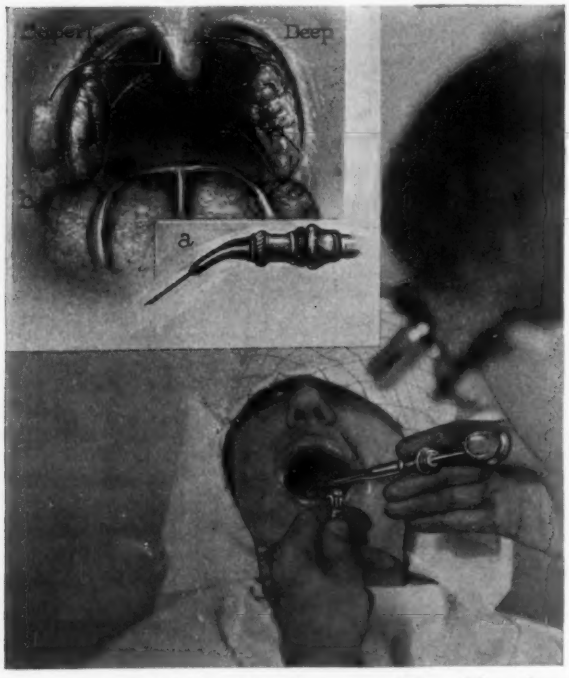

Fig. 3. Superficial infiltration on right side; deep infiltration on left; Lilly syringe.

In trying various tonsil seizing forceps, we found none that suited the needs so well as the Allis forcep used in abdominal surgery. Mueller has modified this by adding 1¼ inches to the length of the shaft between the lock and handle and by making the teeth a bit longer.

The secondary incision, or the circumcision of the tonsil, follows (Fig. 5). A blunt-ended, curved knife is introduced into the submucous plane of each pillar in turn. The point of the blade insinuates itself down as low as the tonsil extends. The sharp edge is now turned backward on the anterior pillar and forward on the posterior pillar. The membrane is gently loosened from its attachment to the tonsil rather than cut through. This spares as much of the mucosa as possible to act as a covering of the inner surfaces of the pillars. There is less bleeding from such an edge than would be from a cut edge. By these incisions nearly one-quarter of the anterior and one-quarter of the posterior surface of the tonsil is at once exposed.

The remaining dissection of the tonsil is now performed (Fig. 6). This may be

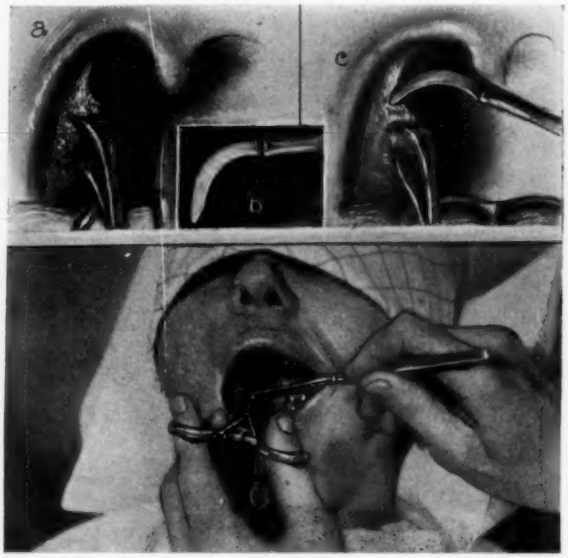

Fig. 4. Primary incision; (a) tonsil seized and mucosa tensed; (b) pointed sickle knife; (c) mucosa being nicked.

done with scissors or the golf-stick serrated dissector. In secondary tonsillectomies or in cases where retrotonsillar scar tissue has followed peritonsillar abscesses, dissection may be done with either the scissors or the sharp edge of the golf-stick dissector. The use of the scissors is often easier and to be advised. As the tonsil is loosened backward one comes to a sort of membranous structure that resists progress of the dissection. This is true also as one dissects forward from the posterior pillar. If a little care is exercised, these two membranes are found to extend from top to bottom of the tonsil at its most external part and to be separated from each other by about 2 or 3 mm. This structure is of surgical significance and importance. The dissection up to this point is usually bloodless. Now if this resisting structure is loosened or cut, practically always there is definite bleeding at once. These two

membranous sheets are the sides of a tube between the fascia over the superior pharyngeal constrictor and the body of the tonsil, like a fin or a mesotonsil. Between these tough membranes the space is filled with loose areolar tissue and blood vessels. Within this tube the principal surgical blood supply runs down behind

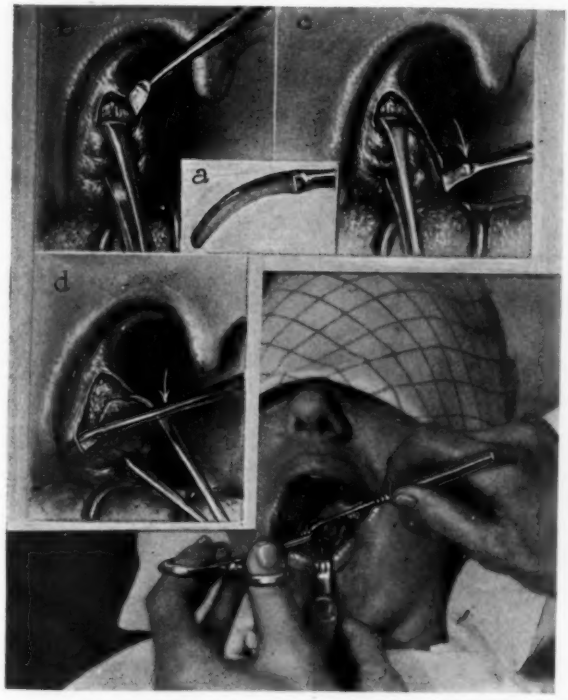

Fig. 5. Second incision, circumscribing tonsil and loosening mucosa at its attachment to tonsil.

the tonsil. The larger arteries run external to the superior constrictor. The smaller vessels then pass over the upper border of this muscle and run down behind the tonsil within this fin as mentioned. As the arteries pass downward lateral branches are given off and penetrate the tonsil mass.

A similar tough band of connective tissue is encountered in freeing the anterior pillar and plica triangularis from the lower pole of the tonsil anteriorly. This indicates the course of the blood vessels coming in to the tonsil fossa from the lingual blood supply.

In opening the supratonsillar fossa and in peeling the tonsil downward from one to several mucous glands are usually revealed. It is our custom to seize and remove these by the tonsil forceps. In some of our own cases and in other cases coming to the clinic, we have seen these flat superficial mucous glands hypertrophy and appear as lenticular masses in the depth of the fossae. On occasion these glands may become inflamed and greatly worry the patient. Also a physician examining the

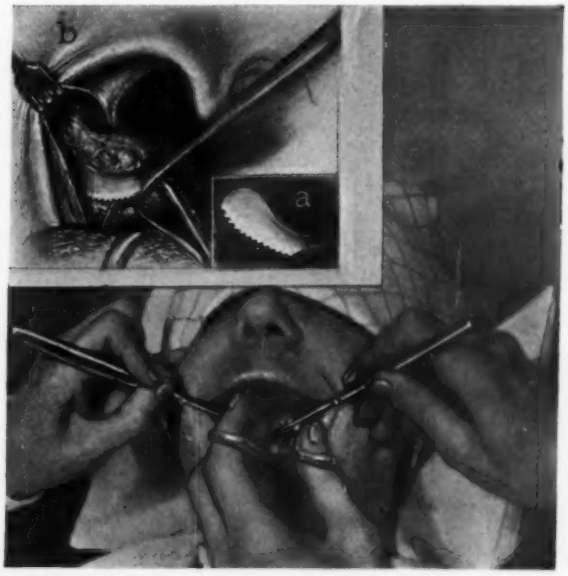

Fig. 6. Dissection with serrated edge of golf-stick knife, keeping very close to surgical capsule.

throat may decide that these inflamed masses are tonsil remnants unfortunately left by the former operator. While such a conclusion and opinion should not be reached, the removal of the mucous gland is to be advised. One German observer claims that he has seen "retrotonsillar" abscesses appear at a time long subsequent to the complete removal of the tonsils, originating in fact from the infection of mucous glands that had been allowed to remain in the fossa.

The lower pole of the tonsil being entirely loosened and exposed anteriorly and the mucosa being dissected down to the extent of the tonsil posteriorly, the tonsil is now removed with a Tydings snare (Fig. 7). The stylet is placed just behind the anterior pillar as low as possible.

In our early experiences the question of what to do with the plica triangularis

was a difficult one to answer. Matthews in those days advocated its complete removal and the dissection of the lymph follicles extending down the pharynx for a short distance below the tonsil. Canfield on the other hand opposed this idea, urging that the plica be conserved. He maintained that the complete removal of

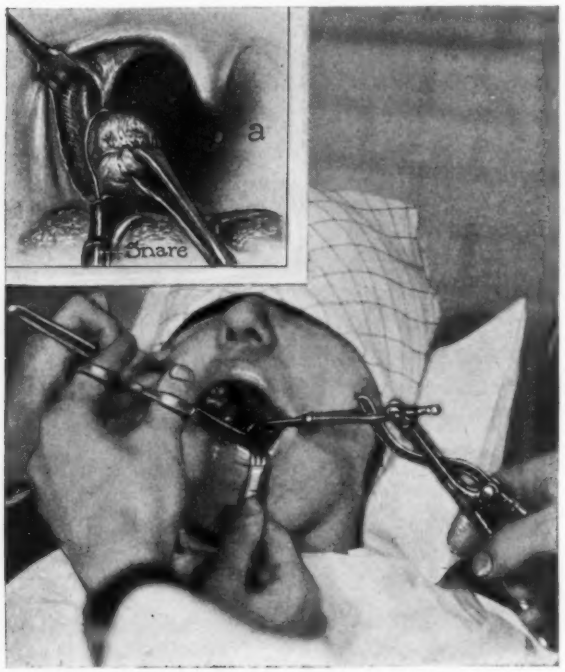

Fig. 7. Removal with Tydings snare. Mesotonsil not completely dissected. In operating dissection is carried considerably further downward.

the plica would often result in a cicatricial binding of the anterior pillar and the tongue, with discomfort and dissatisfaction to the patient. It has been our custom to remove that portion of the plica, if any, that contained prominent lymph follicles and mucous glands. In doing this, we endeavor to retain the attached border and as much of the free plica as is not involved in this gland mass. Occasionally we have observed hypertrophy of the plica mass when the glands were not removed. A few times we have seen this mass drawn in to the fossa and bound down near its lower pole, simulating in appearance a tonsil remnant.

Routine ligation of the superior or principal blood supply is performed (Fig. 8). The needle holder was originally fashioned from a Schnitt gall-bladder forceps. A cut or groove was filed parallel to the course of jaws in the mid-line of the blades. This holds a modified perineal fish-hook needle which has been annealed. The loose connective tissue remaining from the mesotonsil is picked up by the

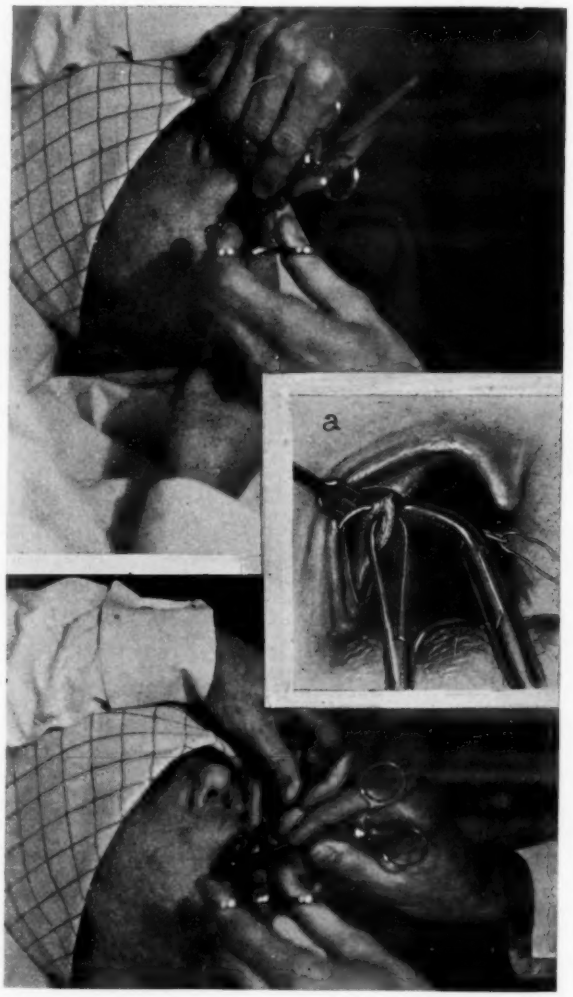

Fig. 8. Inserting ligature through mesotonsil or fin bearing principal blood supply.

forceps high in the fossa. Slight traction is made, and the rather blunt pointed needle is slipped between this areolar tissue and the muscle fascia, carrying a No. ooo silverized catgut ligature. This catgut is of fine calibre and high visibility, being black, and has excellent tensile strength. It absorbs as would plain catgut. The proof of the circulation is established

by this ligation. One may note a point or two of bleeding part way down the fossa. If the point is directly seized with a hemostat and ligated, one might feel that the vessel penetrates the muscle bed and enters the fossa at a right angle to the tonsil. This is not true. Arteries do not pierce muscles to get to and supply some other structure. The course is around the edge of the given muscle. This is true here. The vessels come over the upper edge of the pharyngeal constrictor muscle, pass down behind the tonsil and give off branches that enter the tonsil (Fig. 9). As noted above, this is shown conclusively by ligating the vessel mass high in the fossa, and observing that a bleeding point one-third or one-half way down the fossa stops at once. Occasionally the lesser supply from the lingual region has to be ligated also. This necessity is usually occasioned by carrying the dissection too far away from the tonsil capsule. If the dissection hugs the tonsil, the vessels are divided where they are small and as a rule do not bleed. If necessary to ligate the vessels from the lingual region, the tissue just behind the plica and low in the fossa is seized and surrounded by a ligature on the needle.

After the fossa is dry it is very lightly wiped with an astringent solution consisting of equal parts of glycerine and Monsell's solution, with 2 drams of tincture of iodine to 12 ounces of the mixture. This induces a capillary coagulation that opposes even slight oozing when the epinephine effect passes off and when the patient clears his throat or swallows. On occasion one may insufflate a fine coating of a powder containing two parts of bismuth subnitrate and one part of anesthesin. This also is for the purpose of establishing an early superficial coagulum especially in patients with high blood pressure or in highly nervous patients.

In our clinic the patient is under the direct supervision of the Department of Otolaryngology for the forty-eight hours following the operation. He is immediately put to bed and the following routine employed:

First Day.

1. Have radiant heater in bed before the patient enters the ward.
2. Patient should be in Fowler's position, reclining at night if desired. Ice bags to throat for two or three hours, according to patient's comfort.
3. Begin water drinking three hours after operation, 8 oz. every hour.

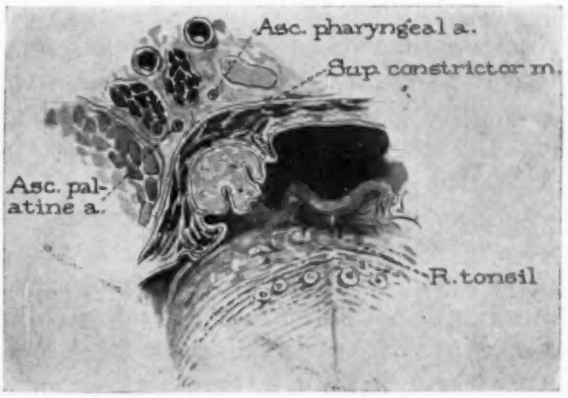

Fig. 9. Relation of main arteries behind and branch arteries in front of superior pharyngeal constrictor.

4. Give atropine grain 1/150 for excessive flow of saliva. Repeat every three hours if necessary. To be given by mouth or hypodermic.
5. For headache, earache or extreme sore throat, give aspirin grain 5, and codeine grain 12 as required and repeat in two hours if necessary. Use 3 drops of 5 per cent phenol and glycerine in ears for earache.
6. No food until evening. Ice cream and bland fruit juices to be given then.
7. No talking, clearing of throat or gargling the first day.

Second Day.

8. Continue water drinking every hour.
9. Gargle five times daily with hot normal saline solution (½ teaspoon to 8 oz. of water). Gargle morning and evening and after meals.
10. Order enema if necessary.

Third Day.

11. After breakfast send tonsillectomy patients in wheel chairs to Nose and Throat Department for treatment. Instruct each patient to gargle throat five times daily and drink water. This concludes the patient's ward care completely unless otherwise instructed by surgeon.

There is a possibility of bleeding in each of three periods. First, at the time of operation. This is controlled by the epinephrin in the novocain solution, by the careful and close-to-the-tonsil dissection, and by the immediate placement of the ligatures.

Second, during the first four or five hours following. This is incidental to the wearing off of the epinephrin effect and to the repeated clearing of the throat by the patient. In most cases there is a little tinging of the mucus with red. As a rule the reassuring of the patient is sufficient. Occasionally the oozing results in the formation within the fossa of a clot which may project or hang into the pharynx. The presence of the clot annoys the patient and induces him to continue the clearing of his throat. The clot itself may hold the tissue crevices open and keep the capillaries oozing. Usually the simple complete removal of the clot causes the capillary oozing to stop at once. Occasionally a touch of 8 per cent nitrate of silver, a drop of Monsell's solution or a few grains of astringent powder may be needed to cause the formation of capillary coagulation. Quite infrequently a definite bleeding vein manifests itself an hour or two after the operation. This requires a ligature.

Third, the so-called secondary hemorrhages occurring about the fifth day, or between the fourth and eighth day. This is surprising to the patient but is not usually of any severity or seriousness. Here again the thorough removal of the clot, especially the last little portions at the actual site of oozing, will cause prompt cessation. A touch of silver nitrate may be needed. We have not experienced a secondary hemorrhage requiring ligature.

The nurse in charge of the operative case is given the following suggestive outline:

HEMORRHAGE

1. Non-important:
   Streaked mucus expectoration.
   Occasional clot.
   Notify surgeon on evening call.
2. Important:
   Repeated expectoration of clots or fresh blood.
   Notify head nurse during day and night physician at night.
3. Urgent:
   Repeated swallowing.
   Flow of blood from mouth.
   Notify head nurse during day and night physician at night and if neither can reach ward promptly call patient's surgeon.

Calmness is imperative. Avoid confusion. Keep patient's bed clean and in order.
Give patient a hypodermic injection of ¼ grain of morphine sulphate unless one has been given within the last hour.
Do not leave immediate vicinity of patient.

On the third morning as noted the patient is brought to the Nose and Throat Department. Here his mouth, the pharynx and the operative field are cleansed with an alkaline solution and are sprayed with neosilvol. He is then returned to the general care of the internist, but with the following instructions from our Department:

For the first two days you have followed a program of rest, quiet and suppression of reaction in the throat. From now on the aftercare is more active, looking toward stimulation of healing and minimizing of the pain and tenderness.

1. Drink freely of water, approximately one glass an hour. The addition of a small amount of baking soda to the water is often quite soothing. The water may be cold, hot or warm as may be most acceptable. Usually a cup of some quite hot drink, at the beginning of each meal, relaxes the throat and helps swallowing.

2. Come in to the Nose and Throat Department daily for one week for treatment. At the close of this time your surgeon will inspect the throat and give advice as to further care.

3. To keep the throat and mouth clean gargle before and after meals and on rising and retiring with a weak salt solution (one-half level teaspoonful of salt to one glass of hot water). The use of any standard mouth wash is permissible.

4. Consult your attending physician in regard to bath prescriptions especially adapted to stimulate the circulation of the neck and throat.

5. Consult the dietitian in regard to your diet. We advise a soft diet.

6. Occasionally a special hot gargle just before meals will further help to relax the throat. For this purpose you may get six ounces of Dobell's solution at the Pharmacy to be used with equal parts of hot water. After the third day the chewing of gum for fifteen or twenty minutes after each meal is often very good to relax the muscles of the throat.

Diabetic patients should get unsweetened paraffin at the Pharmacy instead of the ordinary sweetened gum.

The operative experience falls into three periods, (a) the thinking about it in advance, which to many a nervous patient is by no means a little thing; (b) the operation itself, which if properly conducted is the least part when reviewed in the memory of the patient and (c) afterward, which from the physical side is the most painful and annoying, though from the psychological viewpoint it is much easier than either of the other two.

In our experience the essentials of aftercare are few: general quiet, warmth of the body, inhibition of talking and of clearing the throat, and the free intake of water. Of all these the most important is water, at the rate, when awake, of a glass an hour. We have tried mouth-washes, gargles, troches, tablets, powders, fomentations, ice-bags, massage, and stretching of the pharyngeal funnel by lifting the head when swallowing. Each has its merits and varies in value in different cases. But best of all and the sheet anchor of smooth convalescence is the large water intake as prescribed.

The convalescence likewise falls into three periods, a week to the period. At the end of the first week the patient is physically over being cross or annoyed about the operation. He can eat, drink and be merry as evidenced by laughing. At the end of the second week he has forgotten just what day the operation was done. By now he can yawn, sneeze and even sing if he is so inclined. By the end of the third week he is back to where he was before the operation. The patient or surgeon who expects convalescence of much shorter duration will be disappointed. When one considers that the tonsil operation is at the worst surgical site in the whole body, it is not surprising that it is usually remembered by the graduated patient as a real event. He can join with Irving Cobb in reminiscences. The faucial wounds are all that a surgical field should not be. The pillars are left separated, making a wound which is wide open instead of closed and held by tension sutures, wet rather than dry, infected rather than clean, hot rather than cool, and in constant motion rather than quiet. On one occasion a patient on the second day was observed to have laid aside her book. When it was mentioned, she said: "Yes, it hurts my throat to read." She further explained that any emotion evoked by the reading caused movements of her throat that were painful. Usually reading and sleeping are the favorite pastimes for the first two or three days.

Not infrequently cases present themselves with tonsil remnants remaining after one or more attempts at removal. These cases are always interesting from a clinical and surgical viewpoint. In fact the absorption or focal infection probabilities from such remnants, more or less covered and bound down by cicatricial tissue, are greater than in the average diseased but untouched tonsil. Furthermore the distortion of the pillars and the uncertainty of the findings under the scars always lend an added interest to the operation. The careful approach and dissection by the technique proposed make the handling of these secondary cases relatively simple. The complete removal is insured and the functional activity of the muscles of the fauces is restored to the greatest possible extent.

In three cases observed the palatal distortion was very marked and the uvula apparently amputated. In each case the dissection revealed the uvula to be drawn to one side and grown fast in the upper part of one fossa. It was liberated, the attached raw surface sutured to prevent cicatricial distortion and adhesion again of the uvula to the raw surface of the fossa. In one case the uvula was sutured to the opposite side of the fauces for a few days to insure its being retained in normal relation. Certainly many of these secondary tonsillectomy cases cannot be handled nearly so satisfactorily under general anesthesia as

under local anesthesia with deliberate dissection.

Twenty years ago a patient past forty years of age was considered to be quite an undesirable surgical risk following tonsillectomy. Experience has shown this not to be true. A person of fifty or sixty has as a rule less local reaction and discomfort and no more general depression than a person in the twenties or thirties.

The question must be considered of whether or when to operate on a patient with diabetes mellitus, increased blood pressure, myocarditis, angina pectoris, nephritis, lues, tuberculosis, and organic or functional nervous disease. In diabetes the benefits of the elimination of foci of infection are so evident that diseased tonsils should be removed if possible. The metabolic department carries the patient until his blood sugar and general conditions warrant, and then, with a minimum of delay or opportunity to worry, the patient is operated on. We have had no cause to regret this plan. The same plan is pursued with the cardiac department in relation to cardio-vascular-renal cases. In luetic cases, the genitourinary department indicates when it is proper to proceed. It is not necessary to get a negative serological reaction before operation with complete safety. In neurological cases, whether the benefits that will probably ensue justify and whether the condition of the patient warrants operation must be decided by the attending neurologist. An extremely nervous patient may be controlled by the choice of preliminary hypnotic.

In general, any operation on the nose or throat under local anesthesia is a psychological strain that must be admitted and handled. It is better to surround the patient with quiet, calm, and subdued light during the twenty to thirty minutes after the hypodermic has been given. When the patient is then taken to the operating chair, each move by the nurse or surgeon must be definite and purposeful. The patient may express his emotional agitation in various ways. This psychological swing of his emotional pendulum may be properly allowed to go without repression. After the infiltration has been completed, it is made clear that this is the most annoying part of the whole procedure. The pharyngeal reflex that induces gagging and inhibits breathing is markedly reduced by the anesthetic. During the few minutes between this infiltration and the actual beginning of the operation, the patient practically always relaxes in nerve tension to a surprising degree. If the surgeon at that time can estimate the personal characteristics of his patient so as to say and do the right thing, the emotional swing soon reaches normal. Thus as a rule the few minutes of surgical manipulation are quiet and the procedure closes with the patient in a happy state of mind and without unpleasant memories of the occasion.

A PLEA FOR
EARLY PROSTATECTOMIES

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WHEN a patient with prostatic symptoms presents himself for examination, the urologist is confronted with two equally important problems: (1) the making of a complete and exact diagnosis and (2) the preparation of a definite and appropriate program of treatment.

In the study of a case special care must be taken to determine the exact cause of the symptoms observed. It must not be forgotten that every patient with urinary symptoms should be informed respecting their causes and carefully instructed how these causes may be removed and avoided. To ascertain that the patient is suffering from prostatic trouble without going deeper into the case is wholly inadequate. The particular type of prostatic disease with its predisposing and exciting causes should be determined. Fortunately, urologists now have at their command instruments of precision and standardized methods of examination which makes it entirely possible to do this. A patient who gives a history of frequent urination with gradually increasing nocturia, hesitancy, diminished size of stream, dribbling and dysuria presents a case which requires careful study and complete investigation.

In making a urological examination it is highly essential that a definite and systematic routine should be followed. In general it is not best to complete the examination at a single seance but to proceed with much care and caution. This is particularly true in the case of patients who have never been catheterized before. In very advanced cases it is of the utmost importance. A plan of procedure followed by myself and my associates is the following:

1. After taking a careful history the patient is given two glasses into which he is asked to void urine: into one, the first that he passes, and into the other the last that is voided, particular care being taken to completely empty the bladder. Careful note is made at once of the physical characteristics of the urine and the specimens are then sent to the laboratory for chemical and microscopical examination.

2. The external genitalia are next inspected. Not infrequently a phimosis with stenosis or a visible stricture at the meatus is found to be the sole cause of symptoms. I not infrequently encounter cases of this sort in which a diagnosis of prostatic trouble had been based upon the patient's account of his symptoms without a physical examination and in which the patient had been treated over a long period and of course without receiving benefit.

3. The prostate is carefully palpated through the rectum. Its size, consistency and border outline are carefully noted. By means of a gentle massage of the prostate its secretion is expressed and collected on a slide for microscopic examination. By this means it is possible to differentiate between a chronic follicular prostatitis and simple true hypertrophy of the gland.

4. Next a catheter is passed to determine if residual urine is present, and if so, its amount and characteristics. This part of the examination is highly important for it is the only means except cystoscopy by which a definite idea can be formed of the extent of the impairment present. The prostate by palpation may appear to be normal in size and consistency notwithstanding the fact that 1 to 4 ounces of residual urine is always left in the bladder after evacuation. Enlargement of the

prostate when present may be intravesicular in type or there may be a simple bar obstruction. It is to be remembered that incompetency of the bladder to evacuate its contents may be due to other causes than prostatic enlargement, pathological conditions which are unrecognizable by rectal palpation.

After catheterization an ounce of a 5 per cent solution of argyrol is left in the bladder and the patient is instructed to note the number of urinations in which the dark color produced by the argyrol appears. The argyrol not only prevents infection from the catheterization, which may sometimes occur notwithstanding the use of every known precaution, but is a clear demonstration to the patient of the degree of obstruction from which he is suffering and thus renders him intelligent in relation to the problems with which his physician has to deal.

The patient is given hexamethylenamine and asked to return the next day. If at the next visit the patient reports that the argyrol was seen in four or five urinations or was still present at the end of twenty-four hours, this fact is visible evidence of a definite pathological condition and of the necessity for cystoscopic examination for the purpose of determining the exact pathological condition present. By means of cystoscopy and urography combined, the cause for the urinary residuum may be definitely determined. The findings from such an examination may be a diverticulum (Fig. 1), incompetency of the ureteral vesicular orifice (Fig. 2), stricture of the ureter, urethral stricture, a neoplasm, foreign body, a paresis of the bladder secondary to a lesion of the cord or prostatic obstruction. In certain cases a cystogram is necessary for an exact determination of the pathological conditions present.

In case the obstruction is found to be due to a neoplasm, it is of the utmost

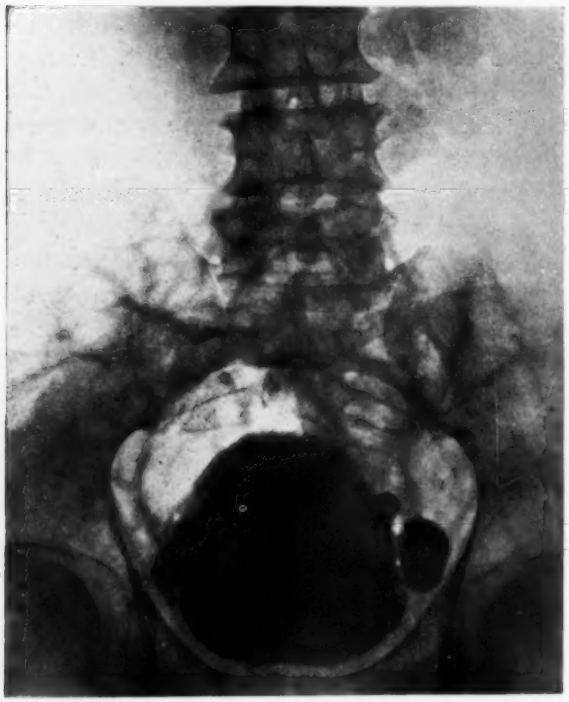

Fig. 1. Small retention type of diverticula which greatly aggravated the bladder symptoms. These gradually enlarge as obstruction advances.

Fig. 2. A case of unilateral renal reflux resulting from an incompetent ureterovesical valve which was produced by the infection and aggravated by the increased back pressure.

importance to determine at as early a moment as possible whether the growth is a simple adenoma or a carcinoma. An early diagnosis in these cases is by no means an easy problem. Special stress is laid upon the intensity of symptoms. In general small quantities of residuum are accompanied by more intense symptoms in cases of malignancy than when the case is one of simple adenoma. Search must be made for small indurated isolated areas in the pelvic bones are sometimes discovered in cases in which no urological symptoms have developed, the symptoms chiefly being pain in the back or in the sciatic nerve.

It is also important to remember that bladder symptoms may be present without prostatic pathology. Urinary frequency and nocturia may be the result of arterial hypertension, an endocrine unbalance or a disturbed carbohydrate metabolism.

If the results of the examination show

Fig. 3. Advanced bone metastasis in a case where the outstanding symptoms were backache and sciatica. Urinary symptoms were minor and were completely ignored by both the patient and his physician.

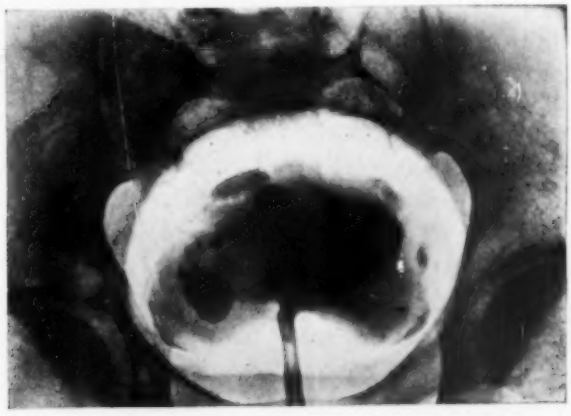

Fig. 4. An advanced case of trabeculation with diverticula which developed in a case in which operation was delayed two years after conditions indicated the need of prostatectomy.

the gland which cannot be made to disappear by gentle massage. It should also be noted that in cases of malignancy massage is not followed by a considerable amount of expressed secretion and also that the gland is unusually hard and less movable than it should be and that its marginal outline is not well defined. In some cases the diagnosis of malignancy may be based upon the demonstration of metastases in the pelvic bones by roentgen-ray examination (Fig. 3). Metastases in

the cause of disturbance to be a benign adenoma or a simple prostatic hypertrophy, what should be our advice to the patient? In my judgment the advice in such a case should be early removal. The let-alone policy still too often followed is an antiquated and obsolete method of dealing with these cases. When we possessed no accurate means of differentiating a simple hypertrophy from other causes of bladder disturbances and when the operation of prostatectomy was accompanied by a high mortality rate and frequently followed by undesirable sequelae, we were justified in assuming a watchful waiting attitude in these cases, but the perfected urological methods of the present day not only give us the means of a high degree of exactitude in diagnosis but enable us to deal with these conditions with a degree of safety closely approximating 100 per cent. Too many patients are still being

advised that prostatic trouble is a natural and necessary accompaniment of advanced age, something which must be accepted and patiently endured. Such teaching is not supported by authoritative urological data and is most harmful. Of course a certain amount of temporizing with palliative local treatment is justifiable and proper, especially while the case is being studied and as one means of becoming thoroughly acquainted with the pathological conditions present, but as soon as it has become clearly apparent that the conditions present cannot be definitely and substantially bettered by non-surgical treatment, radical measures must be recommended and applied. Much harm is done by advising patients to continue palliative treatment indefinitely or until conditions become unbearable before the adoption of radical measures. When such advice is given and followed, what is the result? The pathological conditions present have progressed from a simple uncomplicated state to a highly advanced and greatly aggravated diseased condition. The patient through loss of sleep and consequent lowered vitality has become weak, anemic, depressed and in every way poorly prepared to go through the ordeal of an operation, thus greatly increasing the risk attending the application of the only means which can afford radical relief.

Neglect or delay always leads to the development of complications of various sorts. Stasis is always an open invitation to infection. This is as true in relation to the urine as with the intestinal residues. A moving stream purifies itself while a stagnant pool quickly becomes foul. Residual urine leads to the formation of calculi. The back pressure upon the kidney which often occurs lessens renal efficiency and leads to the accumulation in the blood of nitrogenous waste products, as shown by an increase of non-protein nitrogen. General health impairment results. Digestion is disturbed, often to such a degree that the patient is led to regard it as the chief cause of his ill health. Any tendency to arterial hypertension is increased and changes in the arteries are accelerated. Vicious circles are formed and the patient is hastened on to complete physical bankruptcy. In advanced cases of urinary obstruction trabeculations develop, small, inert diverticuli are enlarged, the bladder pathology is increased and conditions develop which are irreparable, so that the complete relief which might have been obtained by an early operation becomes no longer possible no matter how skillfully the operation may be performed.

Another and still more serious result of delayed action in cases of prostatic enlargement is the development of malignant disease. Cancer of the prostate is usually primary. A reason for this is readily found in the fact that in adenoma of the prostate there are found certain histological elements which under prolonged irritation readily develop into cancer.

The large number of cases of advanced prostatic cancer which appear in every urological clinic are a striking evidence of the terrible price which is paid for the short respite obtainable through delay of surgical treatment. In many of these cases the patient has been treated by dilatation of the urethra, douching of the bladder, massage of the prostate and various other manipulations until the cancerous growth has extended throughout the prostate and has even broken through its highly resistant capsule and invaded the surrounding tissues, even involving through metastasis the pelvic bones. In such cases there is nothing left to be done but to wait for the undertaker. The fact that cancer is found to exist in from one-tenth to one-fourth of all the prostates removed by operation is of itself a sufficient reason for the early performance of prostatectomy in these cases. In view of these facts we are more than justified in the view that on an average at least one out of every five of all cases of prostatic enlargement that come under observation is malignant. The early removal of all prostatic adenoma would certainly save many men from terri-

ble suffering and an untimely and in many cases, to say the least, unnecessary death.

A frequent cause of deferred action in these cases is the apprehension that prostatectomy will be followed by sterility or impotency. Not infrequently patients say, "My doctor advised me against operation, saying, 'Delay it as long as you can for you will be no good afterward.'" Such advice is not soundly based. I know from numerous personal observations that a person who is potent before the operation of prostatectomy will be potent after the operation, and not infrequently patients report an increase of sexual vigor as one of the good results of the operation. Certainly the number of persons who find their sexual vigor increased by the operation greatly exceeds those who experience the opposite effect.

The writing of this article was prompted by a recent consultation with a patient whom I first saw more than a dozen years ago. In 1915, finding him to be suffering from an enlarged prostate, I strongly urged him to submit to a prostatectomy. He declined the operation, however, and for five years sought relief at the hands of many specialists who subjected him to various different procedures and modes of treatment. As I expected, he steadily grew worse in spite of all treatment until his suffering became unendurable and in 1920 prostatectomy was performed. In the meantime such serious complications had developed that a two stage operation was necessary. He was obliged to remain in the hospital several weeks instead of getting out in a few days and his recovery was by no means so complete as it might have been since a considerable degree of irreparable damage had been done as a result of the long delay. Today he says, "What a fool I was to endure all that suffering for five years. How much better off I would be today if I had had the operation done at once when the condition was discovered instead of waiting until I was compelled to submit to it."

Experience with a large number of similar cases has fully convinced me that once a diagnosis of prostatic enlargement is definitely made and when the enlargement is so great as to be clearly responsible for symptoms and the cause of the retention of at least two ounces of residual urine, the patient should be advised to submit to an operation as soon as it can be conveniently arranged. The patient is thus enabled to prepare for his operation without undue haste in the arrangement of his affairs, the surgical hazard is practically nil, his hospitalization is on an average not more than two or three weeks and he can be assured not only of a good recovery from his operation but of the complete disappearance of the distressing and annoying symptoms from which he has suffered and of the added suffering, worry and general health impairment certain to develop when action is delayed. The early removal of the enlarged prostate is in my opinion not only a feasible but a most desirable procedure.

THE REACTIONS OF THE BODY TO THE SHORT COLD BATH

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HYDROTHERAPY is not only the oldest of the physical therapies but without doubt is the most ancient of all remedies used in the treatment of disease. In these days when so much attention is directed to electrotherapy, phototherapy, etc., it may appear somewhat old-fashioned to discuss one of the agents of this ancient system of therapeutics. But without in any way discounting the value of other physical remedies, I believe that hydrotherapy, particularly in the form of short cold baths, will bring about more useful and desirable changes in the functions of the body than any other form of therapeutics.

Formerly used in an empirical way, hydrotherapy in more recent times has been put on a thorough scientific basis as the result of much scientific experimentation and observation. However, the manner of action and the effects of different forms of baths are undoubtedly not generally understood or appreciated.

The writer has made use of hydrotherapy in the treatment of many chronic and acute diseases for more than forty years. At different times experimentations have been conducted on normal individuals for the purpose of studying the physiologic effects of different forms of baths. The reactions of the body to the short cold bath have been particularly studied in these series of experiments, and more recently a careful study in the changes of metabolism, produced by the short cold bath, has been made. The purpose of the present paper is to express in a brief and concise way the results of these experiments.

Cold baths usually mean the application of water to the body at temperatures varying from 80° to 32°F. In the present paper the writer is reporting the effects of the bath at temperatures varying from 90° to 55°F. A short cold bath, as the term is used in this paper, means the application of cool or cold water to the body of from one-half to three minutes' duration, in most instances about one minute.

The cool or cold bath may be applied to the body in different ways and the dosage of cold may be varied, depending upon the manner in which it is applied, the temperature of the water, and the length of time of application.

The most common forms of cold baths are the wet hand rub, the mitten friction, the wet towel rub, the wet sheet rub, the needle bath, the shower bath, the spray douche, the percussion douche, the full tub bath, the plunge, and the swimming bath. In all of these different forms the application of cold water is made to all or some particular part of the surface of the body for only a brief time, from one-half to three minutes. When water is applied to only a part of the body at a time, the length of time necessary to complete the bath would be perhaps ten or fifteen minutes, but the application of cold water to any particular area of the body would be only for a very short time, not more than one-half minute, so that all of these different forms of baths may be classed as short cold baths.

The effects of all these different forms of applying cold water to the body are essentially the same. The difference in the reactions for the different baths is one of degree or quantity rather than one of kind or quality. The different forms of cold baths mentioned above offer a means by which the dosage can be varied from a small

dose, as for instance in the cold wet hand rub, to a large dose, as in the spray douche or plunge bath. In the present paper the effects of the short cold spray bath and the short cold full bath have been particularly studied, and the results obtained from the study of these may be taken to indicate the effect of other short cold applications to the entire surface of the body.

The effects of the short cold bath upon the body are the result of the thermic and mechanical factors that are simultaneously active in the application of the bath. The more important of these is the temperature of the water. A cold bath is taken for the purpose of applying cold to the body. It is the cold in the water that does most of the good. The water is simply a carrier or vehicle of the cold, a convenient way of applying cold to the body.

The application of cold to the body in the form of baths produces two effects, the primary action of the cold and the secondary or reaction to the cold. The primary action is always a depressive action. It depresses the activity of the tissues and the organs of the body to which it is applied. The secondary effect or reaction has an exciting effect. It stimulates the functions of the tissues and organs of the body. The primary effect is usually local; the secondary effect may be local or general or both. It is the secondary or reaction effects that are the most important and upon which the good effects obtained are largely dependent. This secondary or reaction effect of the cold is the result of reflexes that are set up in the internal organs of the body as the result of application of cold to the surface.

In certain forms of baths, such as a cool spray at 90°F., the primary and secondary effects may be equal; in other forms, such as a prolonged cool bath, the primary or action effect of the cold may be in the ascendancy. On the other hand, when a spray or needle bath is applied to the body at a temperature of 60° or 70°F. for a short time, the reaction or reflex effect is greater than the primary or action effect. The good results of the short cold bath are largely the result of reaction to or reflex effects of the cold.

These reflex effects are brought about through the medium of the nervous system. The nerves that carry sensations of heat and cold from the skin towards the central nervous system have their endings in the skin. The surface on the skin immediately overlying the endings of these nerves are known as the hot spots and cold spots. The number of these cold spots on the skin surface varies in different parts of the body, as is illustrated in Figure 1. When the cold water is applied to the surface of the body these cold nerves are stimulated and carry inward nervous impulses which, acting upon the nerve centers in the spinal cord and in the brain stem, set up a series of reflex activities which modify the action of the organs within the body.

It is a well established physiologic fact that the action of the organs within the body may be changed by making impressions on the outside of the body. In fact, nearly all physical therapy is dependent upon this fundamental physiologic principle. The good results obtained by the application of the short cold bath to the body is largely the result of strong and numerous reflexes in the different organs of the body as the result of strong impressions that are made by the application of cold water to the surface.

Figure 2 is a schematic illustration of the nerve pathways from the skin through the nerve trunk, nerve roots and spinal cord, and also shows the efferent pathways from the spinal cord out to the viscera and internal organs. When impressions of cold are made upon the skin there are numerous nervous impulses set up which travel in the afferent pathways to the spinal cord and to the nerve centers in the brain stem. These in-going impulses set up by the application of cold on the skin stimulate the nerve centers in the spinal cord and in the brain stem, and as a result efferent impulses are sent out to the internal organs. In

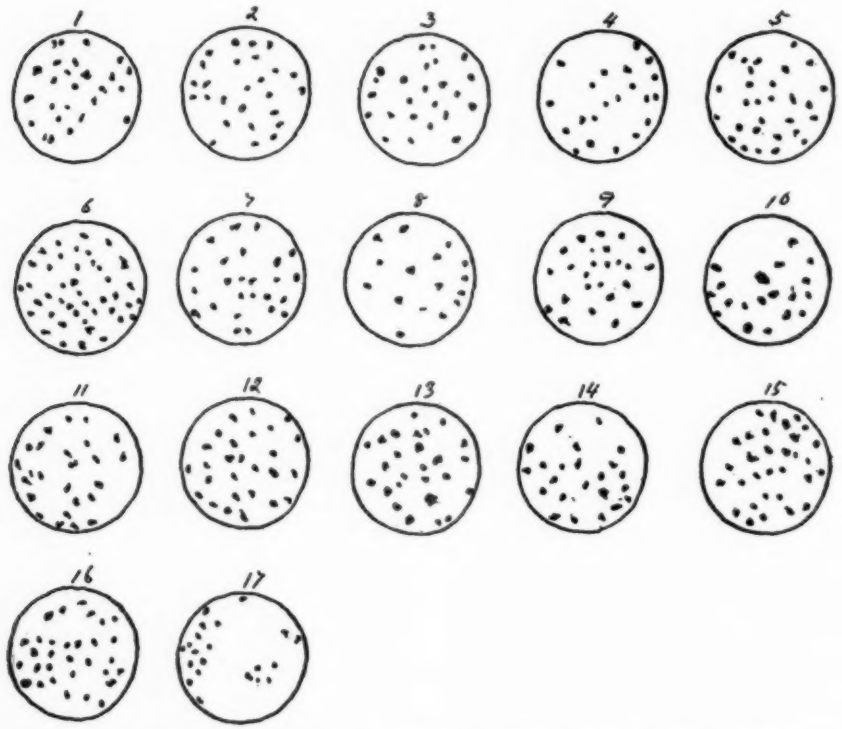


Fig. 1. Illustration showing the number of cold spots in different parts of the body. The number of cold spots in the circle 2 cm. in diameter, in each of seventeen different parts of the body. 1. Forearm, outside; 2. Forearm, inside; 3. Upper arm, outside; 4. Upper arm, inside; 5. Cheek; 6. Forehead; 7. Chest; 8. Abdomen; 9. Thigh, inside; 10. Thigh, outside; 11. Leg, inside; 12. Leg, outside; 13. Upper part of foot; 14. Neck, in front; 15. Upper spine; 16. Lower spine; 17. Back of hand.

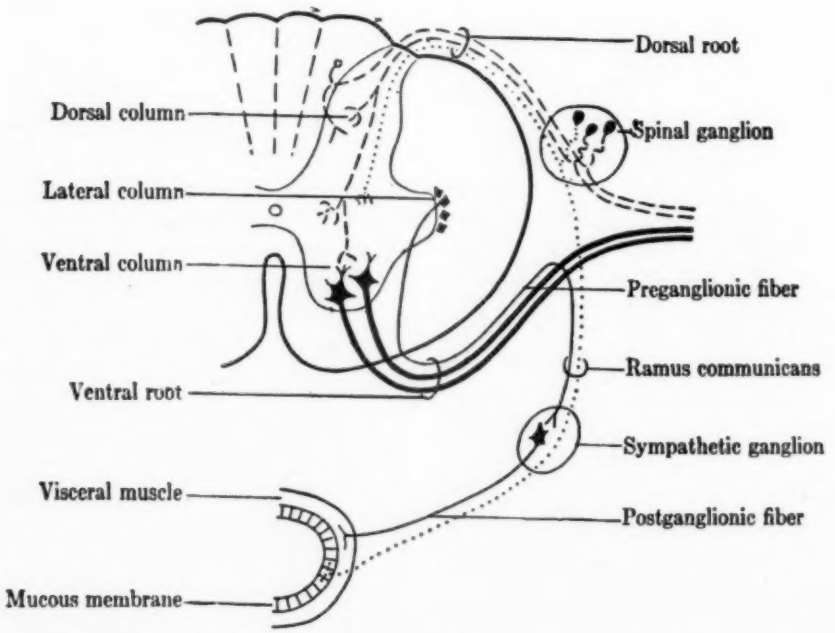


Fig. 2. Illustration (from Ranson) showing reflex pathways to spinal cord. Diagram illustrates the composition of a typical spinal nerve in the thoracic region. The somatic sensory system is indicated by broken lines, the visceral sensory by dotted lines, the somatic efferent by heavy continuous lines, the visceral efferent by lighter continuous lines.

this manner the action of the internal organs is stimulated and changed.

The good effects of the applications of short cold baths to the body are dependent upon the following factors:

1. The ability of the individual to react to the cold. The greater the reaction to the cold the greater the effect. A cold bath at a temperature which may act as an excitant and stimulant to one individual may act as a depressant to another. In the first case the individual reacts to the cold; in the second, he is not able to respond or react, consequently the effect is depressing.

2. The amount of surface to which the water is applied. The greater the area of surface to which the water is applied, other things being equal, the greater is the effect.

3. The temperature of the water. The colder the water the greater is the effect, providing always that the individual reacts to the cold. The effect is greater at lower temperatures because the intensity of the impressions is greater for lower temperatures than for those that are less cold.

4. The mass or quantity of water that is applied to the body at a single moment. The greater the mass or quantity the greater the effect. For instance, a needle spray with few jets of water impinging against the body would have less effect than a similar spray with twice or three times the number of jets impinging against the body. The same principle applies to other forms of baths.

5. The length of time that the water is applied to the body. The longer the time the greater the effect, providing always that the individual reacts. It should be stated, however, in this connection that we are dealing with the short cold bath, the time usually one minute, seldom beyond three minutes.

6. The particular part of the body to which the water is applied. The rule is that the skin over any organ represents the organ beneath; that is, cold applied immediately over an organ will develop greater reflex effects in the organ than cold applied to a similar area of skin in some other part of the body. To illustrate, the effects of local application of cold applied immediately over the heart would bring about greater reflex effects in the heart than the same amount of cold applied to an area of the same size in some other part of the body which is less closely associated reflexly with the heart.

7. The mechanical effects that are produced by the various methods above mentioned, such as friction with the cold mitt or wet towel rub, or the mechanical impact of water on the surface of the body as with the needle spray or douche, etc. These mechanical effects are for the most part the same as those produced by the cold; that is, they set up reflexes which augment and intensify the effect of the cold and their effects are blended with those of the cold.

We may now notice the effect of the short cold bath upon the different organs and systems of organs of the body.

THE SKIN

The effect of the cool or cold bath on the skin may be briefly stated. It produces a contraction of the non-striated muscular tissue within the corium which surrounds the hair follicles, the arrectores pilorum, and produces the elevation about the hair follicles, a condition commonly known as goose-flesh (cutis anserina). This effect is more pronounced if the cold spray be preceded by a warm bath or a warm spray of a few minutes. The cool bath causes a contraction of the blood vessels of the skin and at first produces pallor. This, however, is quickly followed by dilatation of the cutaneous vessels and a ruddy glow results, which is what is meant by the cutaneous reaction to the cold bath. If the bath be continued, the superficial vessels contract again and the skin remains pale for a time.

The short cold bath temporarily lessens the secretion of sweat and diminishes the activity of the sweat glands but this is

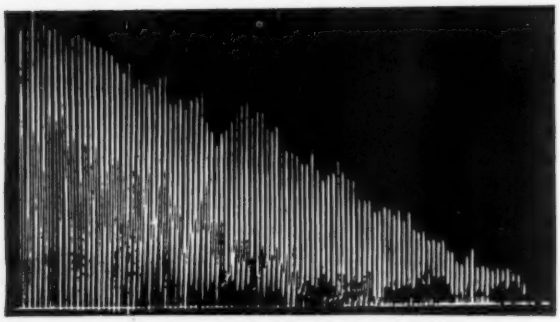


Fig. 3. Illustration (after Kellogg) showing normal fatigue curve; total work 6.703 kgm.

soon followed by a reaction, and when the reaction is strong, as in a young person reacting to a short cold bath of low temperature, the reaction may be so great as to produce increased perspiration.

In many chronic diseases the skin is pale, anemic and inelastic, and more or less wasted and thinned out and sometimes covered with flattened moles and warts, and the circulation of the blood and the nutrition of the skin are very much below the normal. The use of the short cold bath is one of the best means of improving this weakened and diseased condition of the skin. It improves the circulation of blood and stimulates the nutrition in a way that nothing else can do. Its usefulness is often augmented by preceding the cold bath with sunlight baths or some form of phototherapy.

THE MUSCLES

The effect of the short cold bath on the muscles is to increase muscle tone and elasticity, to increase the capacity for work, to increase endurance and lessen fatigue. The increase of muscle tone may be easily observed by feeling the muscles of the arm before and after the bath.

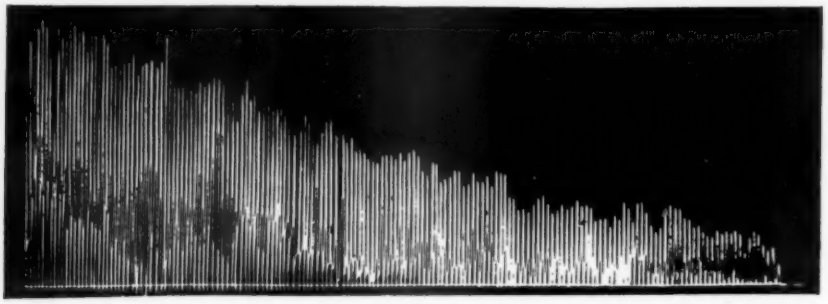


Fig. 4. Illustration (after Kellogg) showing fatigue curve of the same subject after a cold douche; total work, 9.805 kgm.

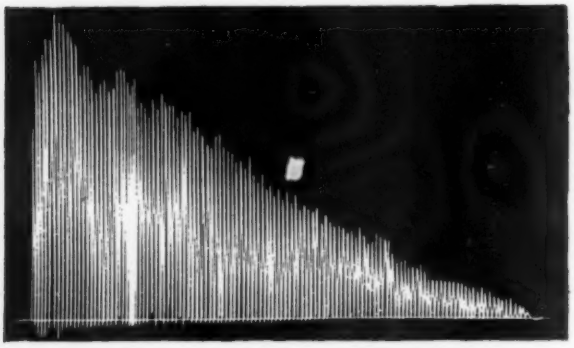


Fig. 5. Illustration (after Kellogg) showing normal fatigue curve of man aged twenty-four years; total work, 8.088 kgm.

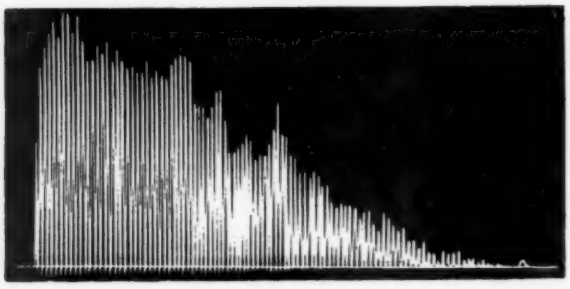
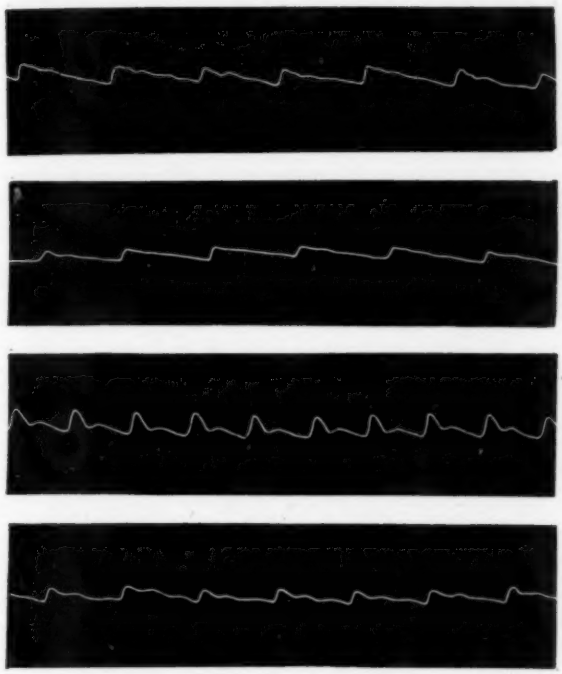


Fig. 6. Illustration (after Kellogg) showing fatigue curve of same subject after a hot bath; total work, 5.152 kgm.

The greater firmness of the muscle to touch and increased elasticity show that the muscle tone is increased. The increased capacity for muscular work and endurance may be easily demonstrated by the use of



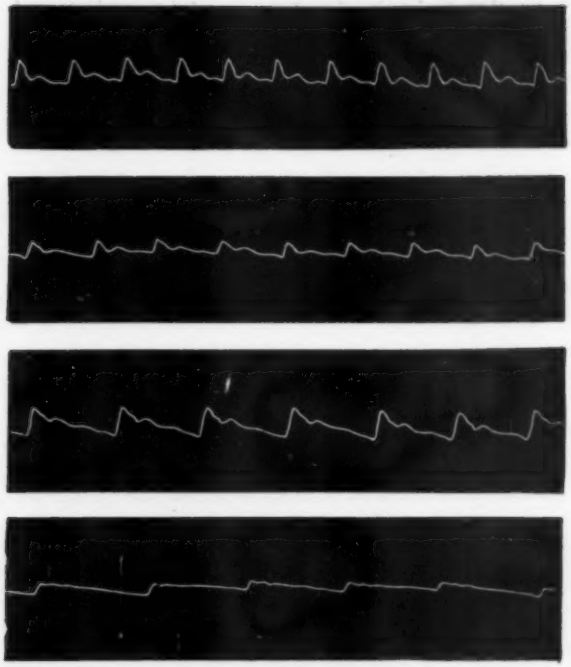


Fig. 7. Sphygmographic tracing of the pulse of Case I just before taking a spray at a temperature of 90°F.

Fig. 8. Sphygmographic tracing of the same immediately following a spray at a temperature of 90°F. for two minutes.

Fig. 9. Sphygmographic tracing of Case II before taking a spray at a temperature of 80°F.

Fig. 10. Tracing of same after taking a spray at 80°F. for two minutes.

Fig. 11. Sphygmographic tracing of Case III before taking spray at a temperature of 70°F.

Fig. 12. Tracing of same after taking spray at a temperature of 70°F. for one minute.

Fig. 13. Sphygmographic tracing of Case IV before taking spray at a temperature of 60°F.

Fig. 14. Tracing of same after taking spray at a temperature of 60°F. for one minute.

Mosso's ergograph which measures the capacity for muscular work and shows the fatigue curve. With the ergograph a tracing may be made of the extent and duration of the movements of the forefinger. These movements are recorded on a revolving cylinder of the ergograph. Each white line made on the smoked paper represents a movement of the finger and the height of the line represents the amplitude of each movement, and the number of lines indicates the number of movements that are made by the finger. In this way the capacity for muscular work and the normal fatigue curve may be established. Figure 3 shows a tracing of this kind before the individual took a cool spray douche. Figure 4 is a tracing after taking a cold douche, and illustrates the increased endurance and increased capacity for muscular work and a lessening of muscular fatigue, all of which were the result of the cold spray douche. Figure 5 illustrates the fatigue curve of an individual before taking a warm bath, and Figure 6 the fatigue curve after a warm bath. It will readily be seen by comparing the tracings in Figure 4 following a short cold bath with the tracing in Figure 6 following a warm bath that the short cold bath increases the capacity for muscular work and lessens muscular fatigue, whereas the warm bath has the opposite effect.

THE CARDIOVASCULAR SYSTEM

The short cold bath increases the force and lessens the rate of the heart beat and increases the tone of the heart muscle; it increases the tone and lessens the lumen of the arteries, it diminishes the diastolic pressure and increases the systolic and pulse pressure and thus accelerates the circulation of the blood. The above mentioned changes in the cardiovascular sys-

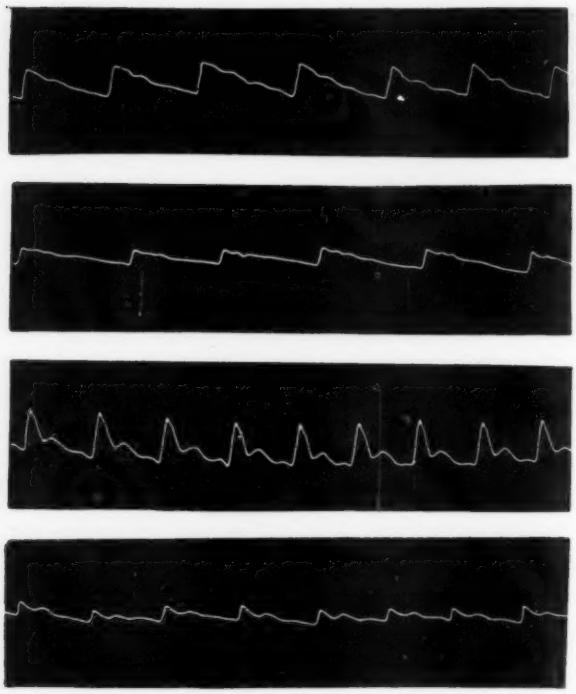


Fig. 15. Sphygmographic tracing of Case v before taking a spray at a temperature of 55°F.
Fig. 16. Tracing of same after taking spray at a temperature of 55°F. for one minute.
Fig. 17. Sphygmographic tracing of the pulse of a young man before placing arm in water of a temperature of 60°F.
Fig. 18. Tracing of the same after the arm had been in water at a temperature of 60°F. for ten minutes.

tem as the result of the application of the short cold bath to the body are illustrated in the following report of the effects of the short cold bath on healthy young men from the ages of twenty to twenty-five years, and also in the report below on the changes in blood pressure (Figs. 7 to 20).

Case I. Before spray at 90°F. for two minutes, pulse is 62 per minute; respiration, 17 per minute; temperature in mouth 98.1°F. Pulse tracing is shown in Figure 7.

After taking spray at 90°F. for two minutes, pulse is 56; respiration, 14; temperature, 98.3°. Pulse tracing is shown in Figure 8.

Case II. Before spray, pulse is 82; respiration, 18; temperature 98.6°. Pulse tracing shown in Figure 9.

Immediately after taking cool spray of 80°F. for two minutes, pulse is 64; respiration, 14, temperature, 98.6°. Pulse tracing shown in Figure 10.

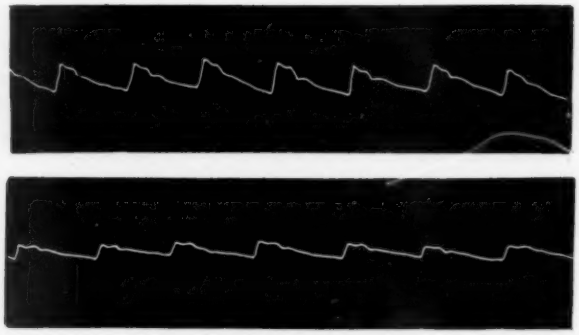


Fig. 19. Sphygmographic tracing of Case vi before taking a full bath at a temperature of 60°F.
Fig. 20. Tracing of the same immediately after taking full bath at a temperature of 60°F. for one minute.

Case III. Before spray, pulse is 76; respiration, 19; temperature, 98.2°. Pulse tracing shown in Figure 11.

After spray at 70° for one minute, pulse is 57; respiration, 16; temperature, 96.6°. Pulse tracing shown in Figure 12.

Case IV. Before spray, pulse is 60; respiration, 17; temperature, 98.6°. Pulse tracing shown in Figure 13.

After spray at 60° for one minute, pulse is 50; respiration, 11, temperature, 98.6°. Pulse tracing shown in Figure 14.

Case V. Before spray, pulse is 60; respiration, 17, temperature, 98.3°. Pulse tracing shown in Figure 15.

After spray at 55° for one minute, pulse is 47; respiration, 19, temperature, 98.2°. Pulse tracing shown in Figure 16.

Case VI. Before bath, pulse is 68; respiration, 14; temperature, 98.8°. Pulse tracing shown in Figure 19.

After full bath at 60° for one minute, pulse is 58; respiration, 13; temperature, 98.8°. Pulse tracing shown in Figure 20.

It will be seen from the foregoing that the short cold bath reduces the frequency of the pulse. The amount of reduction, other things being equal, depends upon the temperature of the bath, the cooler the bath within certain limits the greater the reduction of the rate of the pulse. The reduction in the rate of the pulse also varies with the extent of the surface of the body exposed to the bath. When the spray bath is directed to the whole surface the pulse rate is reduced much more than when only a part of the body is exposed. Placing

the hand in water at a temperature of 60° for ten minutes will reduce the pulse several beats per minute. The amount of reduction in the pulse rate also varies with individuals. In a weak individual a spray of 90°F. for one minute may lessen the pulse rate as much as a spray of 70° or even 60°F. in an individual of more rugged habits.

By referring to the sphygmographic tracings shown in Figures 7 to 25 inclusive, it will be seen that the short cold bath causes very decided changes in the sphygmographic tracing of the pulse. We may note these changes briefly. A sphygmographic tracing of the pulse may be described as a series of curves, each of which corresponds to one beat of the heart. Each pulse curve consists of the line of ascent, the apex and the line of descent.

The line of ascent or up-stroke is nearly vertical. It occurs during the dilatation of the artery and is produced by the systole of the left ventricle of the heart. The apex is the highest point in the up-stroke. The line of descent is gradual and corresponds to the diminution in diameter of the arteries. It is usually interrupted at one or more points by distinct elevations or secondary waves, the most important of which is the dicrotic wave. The height of the up-stroke depends upon at least two factors, the force of the systole of the left ventricle and the condition of the blood vessels. The stronger the systole of the left ventricle, other things being the same, the greater the length of the up-stroke, and the lower the blood pressure in the arteries the greater the up-stroke or percussion wave. A relaxed and dilated condition of the blood vessels favors an increase in the length of the up-stroke of the pulse. The dicrotic wave is more marked the lower the tension of the blood within the vessels. A relaxed condition of the blood vessels, therefore, favors the development of the dicrotic wave.

By referring to the tracings taken before and after the cool spray, it will be seen that besides lessening the rate of the pulse, it diminishes the length of the up-stroke and partially or entirely obliterates the dicrotic wave and increases the length of the line of descent. This does not mean, as might be thought at first from the appearance of the change in the tracings, that the heart has been made weaker, for it can be clearly demonstrated with the stethoscope and by studies of the blood pressure that the force of contraction of the heart is not diminished but that it is positively increased by the short cold bath. The change produced in the pulse tracing means that the muscular coats of the blood vessels have been made to contract and consequently the lumen of the vessels has been narrowed and blood pressure within the arteries increased. With an increase in the force of the systole of the heart together with an active narrowing of the arteries, the blood is driven more rapidly through the blood vessels and the circulation is accelerated. If one listens to the heart tones with a stethoscope he will be able to observe clearly that the intensity of the heart tones is increased following the short cold bath and the rate of the heart beat lessened.

By referring to Figures 30 to 39 inclusive, which are made especially to report the changes in the metabolic rate as the result of the short cold bath but which also illustrate the changes in blood pressure, it will be seen that very decided changes in blood pressure follow its application. These records show that the diastolic pressure is reduced and the systolic and pulse pressure increased immediately following the application of the bath. The reduction in diastolic pressure is undoubtedly due to the fact that the capillaries and arterioles are dilated as an expression of one of the circulatory reactions. This dilatation of the peripheral blood vessels, particularly in the skin, lessens the resistance to the passage of the blood stream in the arteries and capillaries, and this accounts for the lowering of the diastolic pressure. On the other hand, the systolic and pulse pressure are increased as the result of increased force of the heart beat and increased muscle

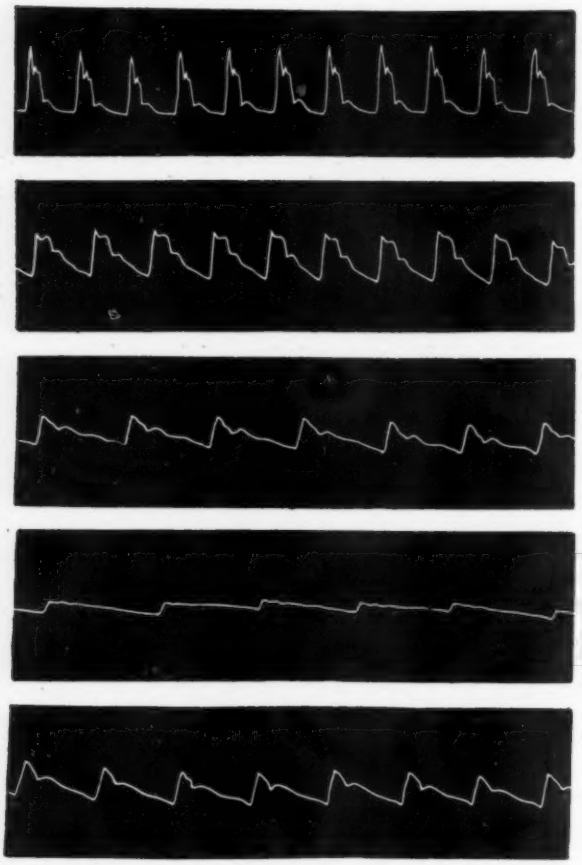


Fig. 21. Sphygmographic tracing of the pulse of a man fifty-eight years old, with hemiplegia caused by hemorrhage.

Fig. 22. The same as Figure 21 after taking a spray bath at 80°F. for two minutes.

Fig. 23. Sphygmographic tracing of the pulse before taking a spray at 60°F.

Fig. 24. Sphygmographic tracing of the pulse taken after a spray at 60°F. for one minute.

Fig. 25. Sphygmographic tracing of the pulse taken after a spray at 110°F. for five minutes, which followed the tracing shown in Figure 24, and illustrates the effect of the warm spray bath on the pulse.

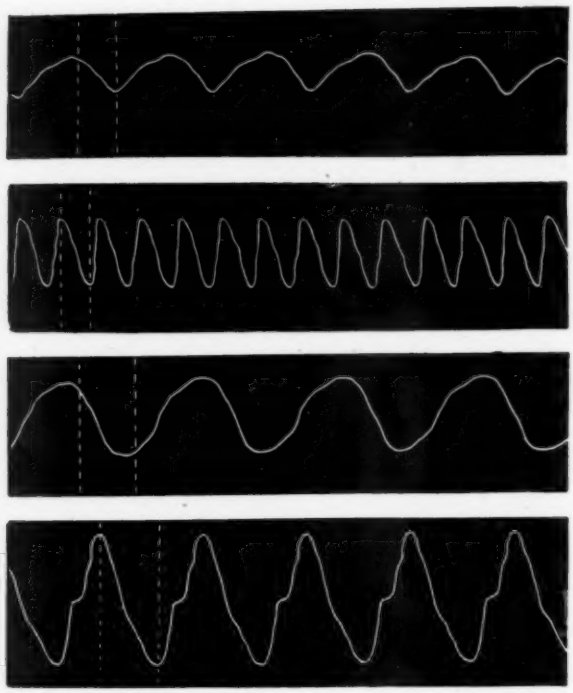


Fig. 26. Tracing of the normal respiratory movements of a young man before taking a shower bath at a temperature of 60°F.

Fig. 27. Tracing of the respiratory movements of the same while in a shower bath at a temperature of 60°F.

Fig. 28. Tracing of the normal respiratory movements of another young man before a shower bath at a temperature of 70°F.

Fig. 29. Tracing of the same in shower bath at a temperature of 70°F.

tone in the medium sized and larger arteries. The increased systolic pressure and increased pulse pressure are evidence that the force of each heart beat has been strengthened. This lessening of the diastolic pressure and increasing systolic and pulse pressure improves the circulation.

The above mentioned changes in the sphygmographic tracing of the pulse are also sometimes very forcibly illustrated in certain diseased conditions. There is a condition of the blood vessels which is sometimes present in individuals suffering from hemiplegia and in persons who may be threatened with apoplexy, to which I wish to refer briefly in this connection. In these individuals the walls of the larger blood vessels are relaxed and not at all or at least very slightly sclerosed, but the course of the vessels somewhat tortuous. The pulse is full, bounding and compressible. A pulse of this character is sometimes observed in persons between the ages of forty-five and sixty years, that is, during the so-called apoplectic period of life. It is perhaps more often present in cases of hemiplegia and in such instances is the underlying pathologic condition which is responsible for the stroke. In the blood vessels of individuals of this class the peripheral resistance in the capillaries and smaller arteries is increased by a thickening of the wall and a narrowing of the lumen of

the smaller peripheral blood vessels. With this narrowing of the lumen of the blood vessels the resistance to the passage of the blood stream is increased and an extra amount of work is required on the part of the heart to drive the blood onward. With this increased resistance at one end of the arterial system and an increased action of the heart at the other, conditions are present which dilate the larger blood vessels. The muscular coats of the walls of the blood vessels become relaxed and weakened and sooner or later give way from the pressure within, and the result is that the individual has an attack of apoplexy. Figure 21 illustrates the pulse tracing of a case of this kind before taking the spray bath at 80° for two minutes, and Figure 22 is a sphygmographic tracing of the pulse after taking a spray bath at 80°F. for two minutes. It will be noted that these changes in the sphygmographic tracings are the same as already referred to above; that is, the length of the ascent is lessened, the descent line is lengthened, and the dicrotic wave lessened, all of which means that the larger arteries have been made to contract and the force of the heart has been increased by the short cold bath.

These same changes in the circulation and in the sphygmographic tracings may also be produced by the local application of the cold bath. For instance, if one arm is placed in water at a temperature of 60°F. and kept there for ten minutes and a sphygmographic tracing made from the radial artery of each arm, it will be seen that not only have the blood vessels of the arm which has been placed in water become contracted and blood pressure increased, but a similar change, although to a less degree, has taken place in the arm which has not been placed in water at all. Figure 17 illustrates a tracing in such a case before placing the arm in cold water and Figure 18 represents a tracing after the arm has been in cold water at a temperature of 60° for ten minutes.

Figure 23 represents a tracing of the pulse before taking a spray at 60°F., Figure 24, a similar tracing of the pulse after a spray at 60° for one minute, Figure 25, a sphygmographic tracing of the pulse taken after a spray at 110° for five minutes. This tracing followed the tracing shown in Figure 24 and illustrates the effect of the warm spray bath on the pulse tracing. A comparison of these figures, namely, the tracing after a spray bath at 60° for one minute which is followed by a tracing after a spray bath at 110° for five minutes, illustrates the changes that can be brought about in the tone and caliber of the arteries by the use of the cold and warm spray bath, the cold bath causing contraction and lessening of the lumen of the arteries while the warm bath relaxes the arteries and increases the lumen. By means of this hot and cold spray bath the muscular coats of the arteries can be put through a course in vascular gymnastics. This means an improvement in the circulation of the blood in the walls of the arteries which are supplied by the vasa vasorum. This gives us a valuable suggestion of one means at least of preventing or delaying arteriosclerosis. When the blood vessels are exercised in this way by means of the warm and cold bath, the circulation of the blood and the normal nutrition of the arterial wall are maintained and sclerosis of the arteries prevented.

RESPIRATION

The effect of the short cold bath on the respiratory movements is apparent. When quite cold water is first applied to the body the respiratory movements are rapid, spasmodic, irregular and shallow, and considerable difficulty is experienced in breathing. In a short time, thirty seconds or so for most temperatures, the respiratory movements become more regular and deeper, the lungs are more completely filled with air and the respiratory movements continue rapid throughout the bath. The respiration may be as great as thirty or forty or even more per minute in a shower bath at a temperature of 70° to 60°F. At the end of the bath for a short

time the respirations are slower and not infrequently shallower than before the bath but this condition lasts for only a few minutes. The real lasting and beneficial effect of the short cold bath is an increase in the depth of respiration and lung capacity, and consequently an increase in the capacity for the absorption of oxygen. The girth of the chest may be increased two or three inches by the continued use of the short cold shower bath for a period of two or three months, as has been frequently demonstrated.

This change in the respiratory movements is also brought about largely by the reflex action through the medium of the nervous system. The stimulation of the nerve endings in the skin by the cold bath sets up innumerable afferent nerve currents from a large part of the surface of the body which powerfully impress the respiratory centers in the medulla and upper part of the spinal cord. These respiratory centers are most effectively stimulated with cold applications to the trunk of the body and particularly the lower part of the chest, but they may also be stimulated by the application of cold to the extremities. It requires, however, a much lower temperature to affect the respiration by cold application to the extremities, and the respiratory center is more easily affected by applications to the proximal end of the extremities than to the distal end.

Figure 26 represents a tracing of the normal respiratory movements in a healthy young man taken just before the cold shower bath at 60°F. Figure 27 represents the same tracing of the respiratory movements while in the shower bath at 60°. Figure 28 represents the tracing of the normal respiratory movements just before taking a shower bath at 70°. Figure 29 represents the tracing of the respiratory movements of the same while in the shower bath at a temperature of 70°. It will readily be seen from these tracings that the cool shower bath increases the rate and depth of respiration. This means that more oxygen is present in the lungs and the supply of oxygen to the blood is increased.

CHANGES IN METABOLISM

Among the most interesting and important changes brought about in the functions of the body by the application of the short cold bath are those of metabolism. For the purpose of making a study of the changes in metabolism during and following a short cold bath, numerous experiments were made on healthy young men under the general direction of the writer by his colleague, Dr. Paul Roth. A normal basal metabolic rate for each individual was obtained first before the bath was given, then the cold bath was applied to the body and the metabolic rate taken immediately following the bath. In addition to observing the changes in metabolism, changes in the pulse rate and the systolic, diastolic and blood pressures were also observed, both before and after the bath. The result of these studies on metabolism is graphically illustrated in Figures 30 to 39. Figure 30 shows the metabolic rate before and after a neutral bath. This test with the neutral bath was made largely for the purpose of determining any change that might be produced in the metabolic rate by exercise and other factors that are incident to the bath, which, of course, should be eliminated or subtracted from the total changes in metabolism resulting from the short cold bath.

The temperature of the bath in these different experiments varied all the way from 85° to 60°F. and the time from one-half to three minutes. The kind of bath and the temperature and duration of the bath are indicated in each of these charts. It will be seen from a study of these graphic charts that the metabolic rate following a short cold bath was increased all the way from thirty points to one hundred five points. The increase varied with different individuals and with changes of temperature of the water and

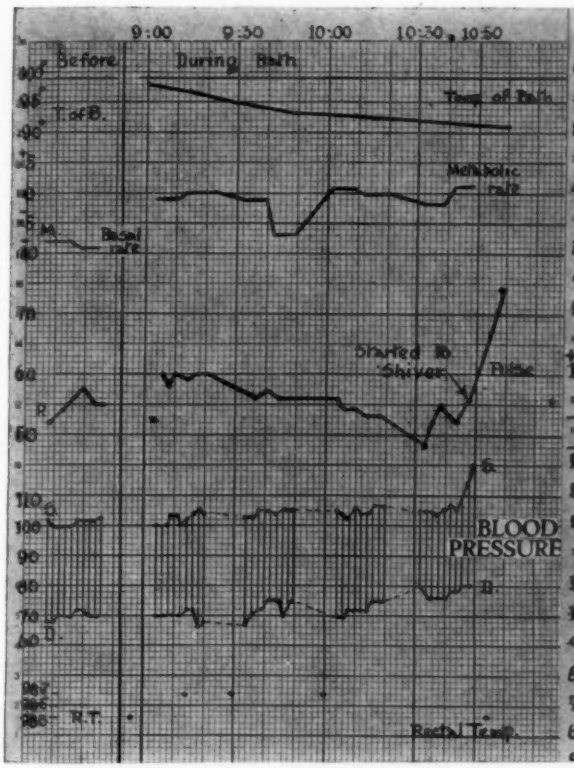


Fig. 30. Physiological effects of neutral bath. Subject: C. B. H. April 18, 1924.

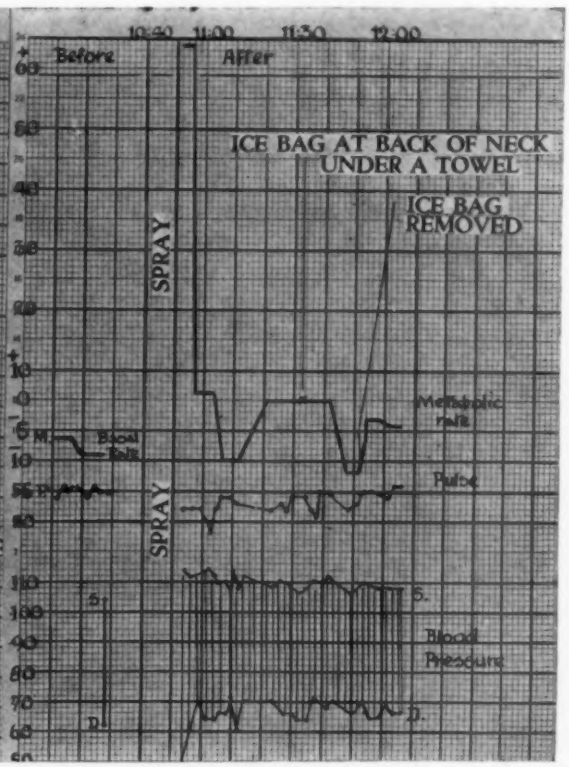


Fig. 31. Physiological effects of spray, 95° to 85° for two minutes. At 85° for one minute. Subject: A. T. C. February 12, 1924.

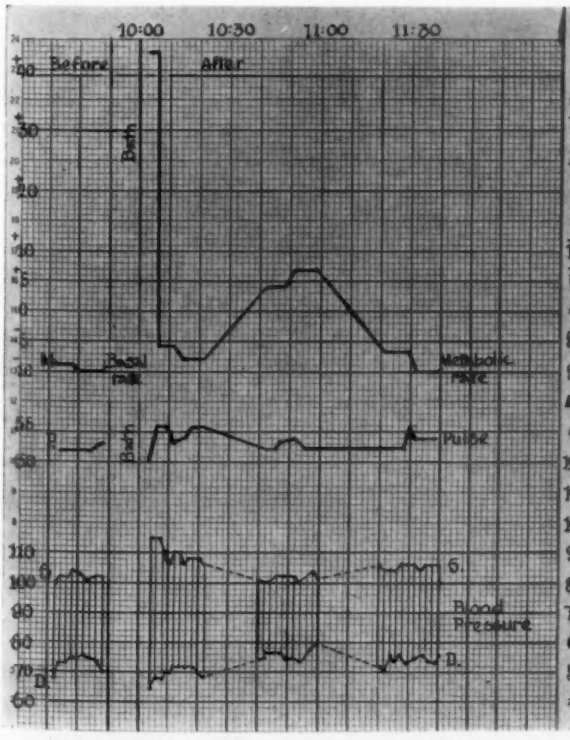


Fig. 32. Physiological effects of bath, 95° to 80° for two minutes. At 80° for one minute. Subject: A. T. C. March 18, 1924.

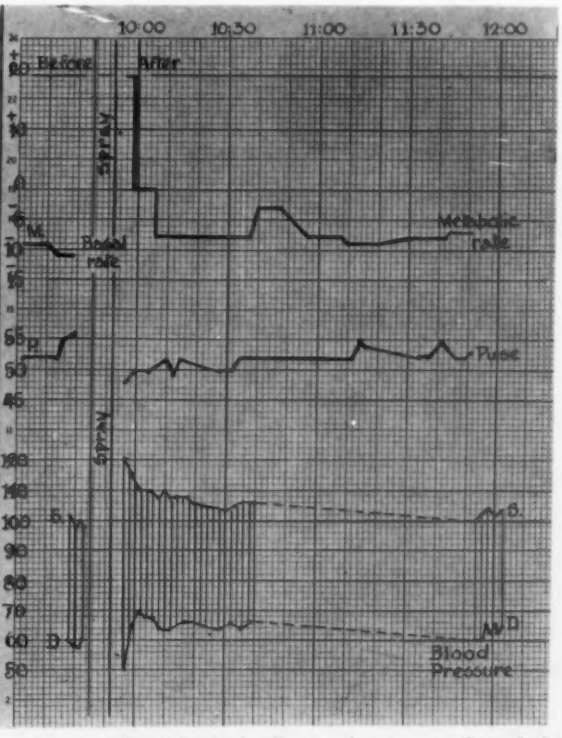


Fig. 33. Physiological effects of spray, 95° to 80° for two minutes. At 80° for one minute. Subject: A. T. C. February 14, 1924.

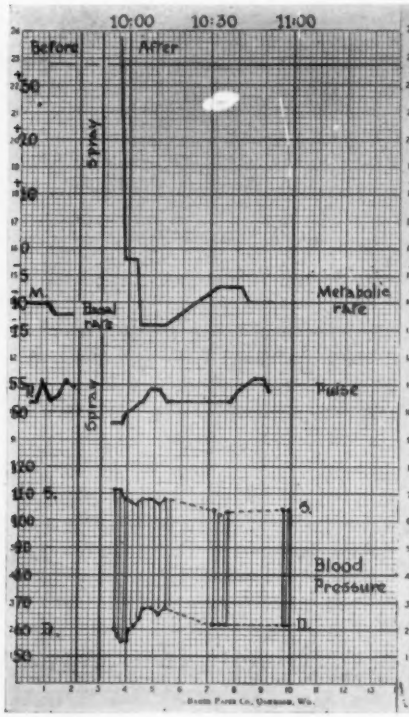


FIG. 34. Physiological effects of spray, 95° to 75° for two minutes. At 75° for one minute. Subject: A. T. C. February 17, 1924.

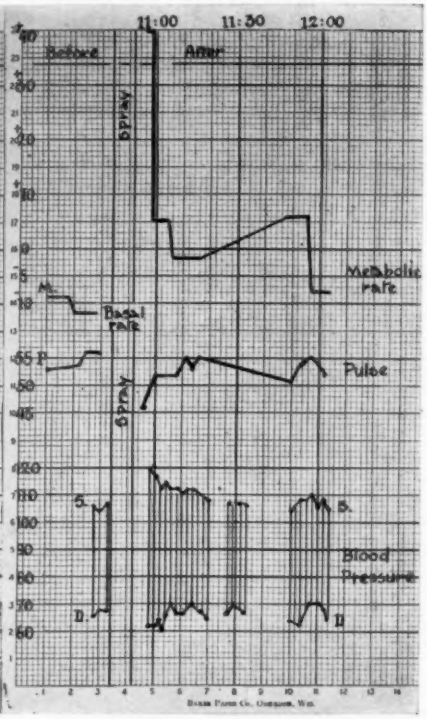


FIG. 35. Physiological effects of spray, 95° to 70° for two minutes. At 70° for one minute. Subject: A. T. C. February 20, 1924.

the length of time that the water was applied, the rule being, the colder the water and the longer the application, within certain limits, the greater the increase in metabolism. The application of cold water in any particular case did not continue longer than three minutes. This very decided increase in the metabolic rate continued for only a short time and then dropped back to normal or near the normal. During this short period in which the metabolic rate is greatly increased the chemical changes going on in the body, of course, are greatly increased and accelerated. More oxygen is absorbed and taken in by the tissues from the blood and entered into chemical combination. The production and elimination of CO_2 is increased. Heat production is also increased. All of this means that the chemical changes going on in the body have been greatly stimulated and increased. The short cold bath thus affords a valuable means by which the chemical changes of the body can be stimulated and by repeated application brought up to a higher level of activity.

One of the most important functions of the body is that of heat production. Quite often this function, particularly in certain chronic ailments, hypothyroidism, myxedema, and in the later years of life, may be greatly lessened and the fire of the body burn at a lower ebb. In cases of this kind the short cold bath when properly given is a valuable means of increasing the chemical activities of the tissues of the body and thus stimulating heat production. When used for this purpose, of course, it should be repeated once or twice a day over a considerable length of time. There are two ways by which the body may be warmed, one by using the short cold bath and the other by the use of some form of warm bath. When the short cold bath is used heat elimination and heat production are both increased. When the warm bath is used heat production and heat elimination are decreased. In a healthy individual after a strong reaction

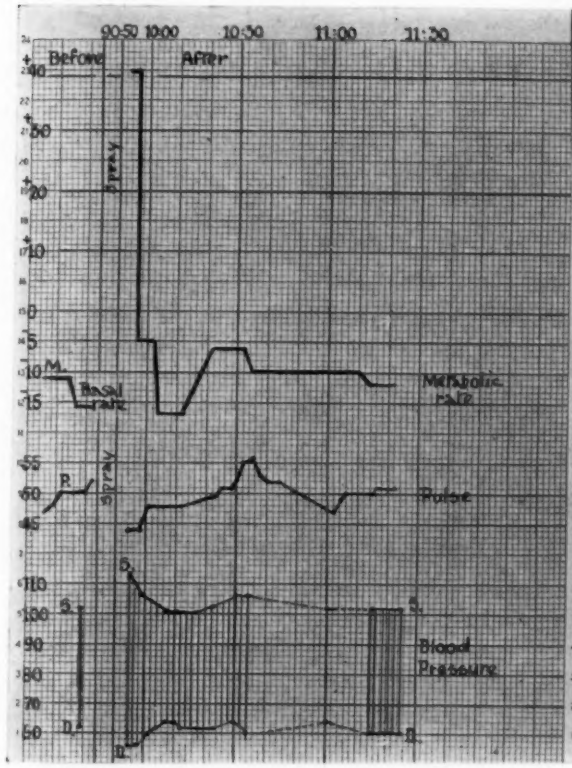


Fig. 36. Physiological effects of spray at 60°F. for one minute. Subject: A. T. C. February 4, 1924.

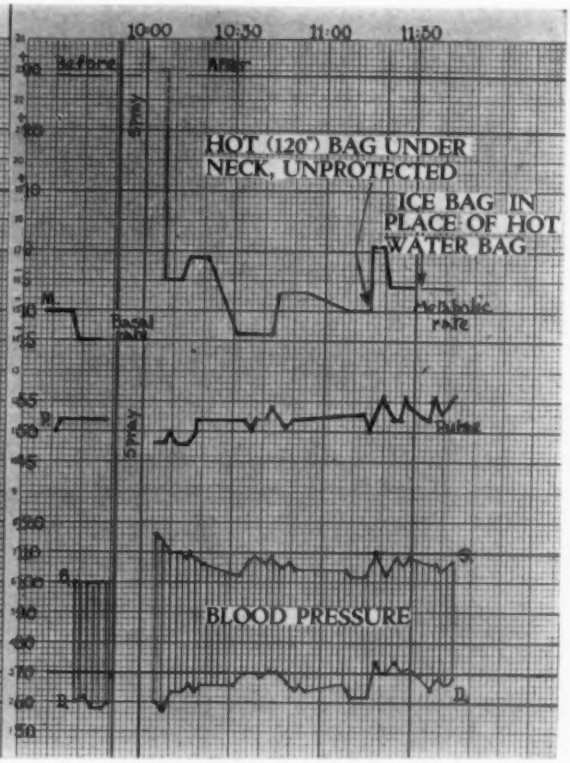


Fig. 37. Physiological effects of spray, 95° to 85° for two minutes. At 85° for two minutes. Subject: A. T. C. February 13, 1924.

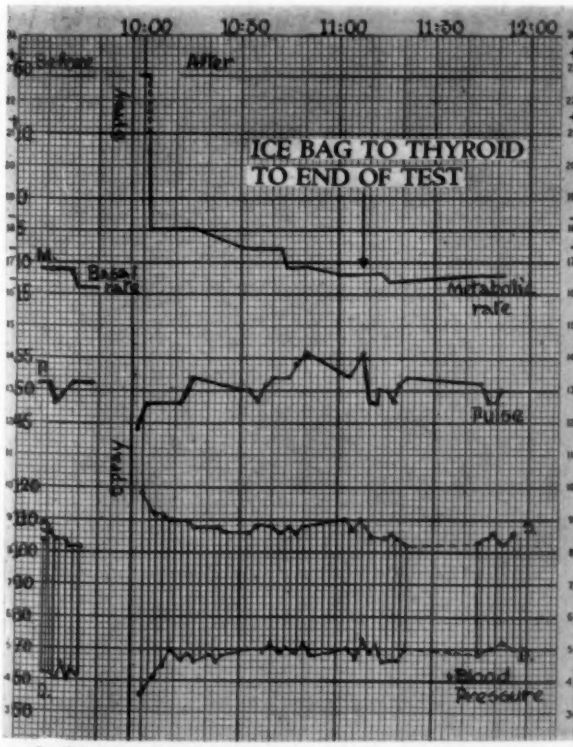


Fig. 38. Physiological effects of spray, 95° to 80° for two minutes. At 80° for two minutes. Subject: A. T. C. February 15, 1924.

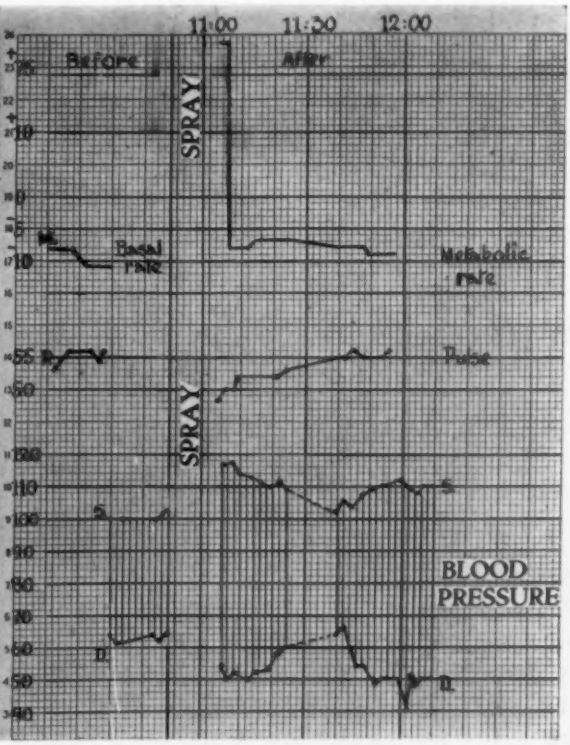


Fig. 39. Physiological effects of spray, 95° to 75° for two minutes. At 75° for two minutes. Subject: A. T. C. February 19, 1924.

to the short cold bath, perspiration is often increased as the result of increased heat production and the stimulation of the sweat glands. The short cold bath, therefore, when properly given is a very valuable means of stimulating heat production and maintaining a normal body temperature.

These charts showing changes in the metabolic rate as the result of the short cold bath also illustrate the changes in pulse rate and changes in blood pressure. From a study of these charts it will be seen that the pulse rate is lessened and that the diastolic blood pressure was decreased and the systolic and pulse pressure increased. These changes in pulse rate and blood pressure also varied with the individual and the temperature and duration of the bath; the colder the water and the longer its application, within certain limits, the greater were these changes in pulse rate and blood pressure. Some of these changes in blood pressure were of considerable degree, as illustrated in Figure 39, in which the diastolic blood pressure dropped at least twelve points and the systolic blood pressure increased at least eighteen points, making an increase in pulse pressure of thirty points, which was nearly double the pulse pressure before taking the bath. Since the pulse pressure is a measure of the force of the heart beat, it will be seen that the force of the heart has been greatly increased by the application of the short cold bath. By lessening the rate of the heart beat and increasing its force, the nutrition and tone of the heart muscle are improved. The lessening of the diastolic blood pressure means that the peripheral resistance in the capillaries and arterioles has been lessened and the increase in the systolic and pulse pressure means that the force of the heart has been increased. This lessening of the resistance in the capillaries and arterioles and increasing the force of the heart are very potent factors in increasing the movement of the blood and improving the circulation.

THE BLOOD

These experiments also show that the short cold bath when taken daily and repeatedly for some time increases both the red and white blood cells and the hemoglobin. This increase in blood elements is undoubtedly brought about by an increase in the activity of the blood-making organs of the body and also as the result of stimulating and increasing the function of other organs and stimulating nutritional changes. In dealing with any particular form of anemia, of course, the cause of the anemia should be looked for and as far as possible removed. Other remedies may also be used in addition to the short cold bath.

When the hand or the foot is placed in the cold bath for five to ten minutes or longer, the number of both white and red cells in the blood is greatly increased. This increase in the blood cells as the result of a local application of cold for a short time is undoubtedly due to a greater influx of blood in the blood vessels of the hand or part that has been exposed to the cold water. It does not mean that the total blood cells in the body have been increased in this short time since, of course, this would be impossible. It simply means that there has been a greater movement of the blood to the part of the body that has been exposed to the cold water.

THE DIGESTIVE SYSTEM

The short cold bath stimulates all the different functions of digestion. It improves the appetite, increases the secretion of gastric juice in cases in which it is below the normal and the glands of the stomach are not destroyed. It increases the peristalsis of the stomach and intestines, and is a valuable adjunct in the treatment of constipation.

THE KIDNEYS

Analyses of the urine before and after the short cold bath show that when repeated two or more times daily it increases the function of the kidneys.

After a series of baths the quantity of urine, the total solids, and the amount of urea are all increased. The increase in the total solids and urea are probably also in part due to the increase in metabolism and the chemical changes going on in the body as the result of the short cold bath.

THE NERVES

The first effect of the cold bath is to increase the irritability and conductivity of both sensory and motor nerves and thus improve their function. Prolonged application of cold lessens the irritability and conductivity of the nerves and thus decreases their function.

From what has been stated it will be readily seen that the effect of the short cold bath on the body is to increase the activity of all of its different functions, and because of this it has a very wide application for usefulness and is an excellent tonic. It will not be possible in the present paper to discuss all the different diseases in which its use is indicated, but a few general indications may be mentioned.

It is very useful in all asthenic and neurasthenic states and in all chronic diseases where the different functions of the body are below normal. It is useful in various digestive troubles, constipation, different forms of anemia, and in cases where the circulation is below the normal. It is very valuable in improving vasomotor tone and the tone of the heart muscle and in cases of low blood pressure. There are many individuals who lead a sedentary life and who develop a weak heart muscle and a condition in which the muscle tone of the heart is greatly decreased. A short cold bath repeated daily is one of the best heart tonics when properly used. In cases of severe diseases of the heart, it should be used cautiously and care should be taken that too cold applications are not made in cases where the heart muscle is very weak. It is very valuable where the metabolic rate has dropped below the normal as in hypothyroid conditions, myxedema, and in all conditions where metabolism and oxidation need to be stimulated. It is also valuable when properly used in cases of diabetes mellitus as it will aid in burning up the excessive amount of sugar in the blood. It is also useful in obesity and many other diseases.

A great deal of skill may be shown in prescribing the short cold bath. It is important that the temperature and duration of the bath be suited to the needs of the patient. Too long an application or too large a dose of cold might do harm. The dosage of cold should be measured out by the physician with as much care as he would measure out a dose of medicine for his patient.

CAUTIONS AND CONTRAINDICATIONS

1. A short cold bath should never be taken when the body is cold. In this condition a warm bath is indicated rather than a cold one. It is usually a good plan to take a warm bath before taking a cold bath, or at least to have the body warm. If the body is already warm, it may not be necessary.

2. A short cold bath should never be taken when the body is tired, as it increases the activity of all of the organs of the body and liberates energy. When one is tired his ability to react to the short cold bath is greatly lessened and consequently he cannot get as much good from it as when he is rested.

3. There are certain conditions and diseases of the body where the short cold bath may be contraindicated or should be used very cautiously and in small doses. In conditions of shock and collapse the use of cold is contraindicated. During the two extremes of life, that is, in infancy and old age, cold should be used very cautiously.

4. In diseases of the kidneys the application of cold water to the body should be used very cautiously, and in advanced disease of the kidneys it is contraindicated. There is a very close relation between the kidneys and the skin, and in advanced diseases of the kidneys the application of cold to the surface of the body may greatly interfere with the function of the kidneys.

5. In cardiovascular diseases and arteriosclerosis, particularly in the advanced stages of these conditions, cold should be used with caution and in small doses, also in high arterial hypertension. In patients suffering from an apoplectic stroke or in the hemiplegic state following apoplexy, cold should be used in small doses and cautiously.

6. In hyperthyroidism and in all conditions where the metabolic rate is above the normal, a short cold bath is contra-indicated as this increases the metabolic rate.

In cases where cold should be used cautiously and in small doses a short cold bath may often be used to good advantage in the form of a cold wet hand rub, cold mitten friction and cold wet towel rub, or some other similar mild application of cold. By these methods the tonic effect of the cold may be obtained without aggravating disturbing symptoms.

CONCLUSIONS

A short cold bath increases the circuation and nutrition of the skin, increases muscle tone, increases muscular endurance and capacity, lessens muscular fatigue, increases the force and lessens the rate of the heart beat, increases the tone of the heart muscle, increases the tone and nutrition of the blood vessels, increases systolic and pulse blood pressure, decreases diastolic pressure, stimulates and improves the circulation, increases the depth and rate of respiration, increases the oxygenation of the blood, increases absorption of oxygen, increases the metabolism and chemical changes of the body, increases the production and elimination of CO_2, increases heat elimination and production, increases the number of blood elements and hemoglobin in the blood, improves the appetite, stimulates digestion, increases peristalsis of the digestive tract, helps to relieve constipation, increases the activity of the kidneys, increases the output of total fluid, solids and urea in the urine, increases the normal irritability and conductivity of the nerves, improves nerve tone, and is a general tonic. Its use and contraindications are given.

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EDITORIAL

SOME OBSERVATIONS ON THE PROBLEM OF CANCER CONTROL

WILLIAM B. COLEY, M.D.

NEW YORK

VERY recently a highly concentrated and powerful effort was made by the officers of the American Society for the Control of Cancer to place before the laity the main facts regarding cancer. The daily press is to be commended for its generous and wholehearted cooperation. The Society is to be congratulated on the success they have had in raising the $1,000,000 endowment which they set up as their goal a year ago. Now there arises the question, and a most important question, of the way in which the income of this fund can be spent that will prove most effective in bringing about a decrease of the steadily rising mortality of cancer or a lessening of the increase of the disease. By such campaigns as the one that has just closed and by widespread distribution of tracts containing important knowledge about the early symptoms of cancer and the importance of seeking early medical or surgical advice and treatment, some patients will be brought to consult a physician more promptly than heretofore. The number of lives saved thereby, however, will have no appreciable effect on the steadily rising mortality. The American Society for the Control of Cancer has been working hard and steadily for more than a decade and a half, but so far there has been no evidence of a decrease in the mortality of cancer. This does not mean that their efforts have been in vain, for without them the mortality doubtless would have been somewhat higher. But it does mean that we should not rest content with efforts merely in the direction

of education of the laity but should extend our efforts along other lines, some of which may prove of far greater promise.

First, more attention should be given to the education of the physician to enable him to make an earlier diagnosis. While not so frequent as formerly, it is still a very common experience with most surgeons to have a patient give a history of having consulted her family physician shortly after noticing a lump in the breast, and being told to apply some simple remedy or to pay no attention to it until it gave her some trouble. In other words, the policy of watchful waiting is still carried out to a much greater extent than is generally believed in the treatment of tumors of the breast and of cancer in general.

The early diagnosis of malignant tumor is often attended with the greatest difficulty even in the hands of experts who have had a large experience with cancer. Therefore, we can hardly expect the general practitioner who sees very few cases of cancer to make an early diagnosis.

The greatest difficulty, and one that still persists in spite of all our increased knowledge of malignant disease and of improved methods of diagnosis, is to be found in the great field of intra-abdominal cancer. Cases without number could be cited to show how very difficult it is to make a diagnosis of cancer of the abdominal cavity sufficiently early to give any hope of a cure by operation or any other form of treatment. When we consider that one-third of all cases of cancer occur in the stomach and liver, to say nothing of those which occur in the rest of the intestinal tract, we see at once what a large proportion of patients cannot be saved by early diagnosis.

If there is any field in which an early diagnosis should be made it is in cancer of the lip, tongue and mouth. The patient is usually aware of the fact that even a small lesion of the mouth or tongue may be dangerous and he usually consults a doctor early. While radium and roentgen ray alone or combined with surgery have undoubtedly enabled us to save more lives in this large field, the prognosis is still very bad.

A study of the statistics of Barker[1] shows that in England and Wales from 1911 to 1920 inclusive, 175,871 males and 224,503 females died of cancer. In more than 60 per cent of the fatal cases the disease attacked the region in or about the alimentary canal. A review of the statistics of the United States registration area shows that in 1924 there were 91,138 deaths from cancer of all organs, of which 12,603 occurred in the peritoneum, intestines and rectum and 34,250 in the stomach and liver. In other words in no less than 46,853, or more than one-half of the total number of cases, the disease occurred in regions in which, even with the aid of an early diagnosis, the chances of effecting a cure by any known method of treatment were exceedingly small.

The laity are constantly blamed for a pessimistic attitude towards surgery and the recognized methods of treating cancer, but if we would stop for a moment and make a careful analysis of the end results of these methods, we might be more sympathetic with this attitude. While we like to estimate the results of operation by the reported results obtained by a few of the most skillful surgeons in special fields, the laity with more reason base their opinion upon the results of operations performed upon persons whom they have known and by surgeons in their own locality; in other words, upon the average results. It is all important that the profession at large should know what these average results are, but thus far the necessary data for determining such results have not been available. Fortunately the importance of obtaining such data is being realized, and one of the first to make a noteworthy contribution in this direction was Dr. Charles L. Gibson[2] of New York, Professor of Surgery, Cornell University Medical College, who published the end

results of 573 cases of malignant disease observed on the First Surgical (Cornell) service of the New York Hospital, from February, 1913 to January 1, 1926, a period of thirteen years. Of 437 patients operated upon, 308 were dead; only 64 were known to be alive and free from recurrence at the time of the report, and only 13 were alive for a period of five years after operation. Dr. Gibson states: "No sadder report of the disheartening status of cancer surgery has come to our attention. It is, however, inevitable, dealing only with facts." He further states:

> Before adopting too harsh a conclusion it should be remembered that this paper is practically a unique contribution to the subject. While the total number is not impressive, I find no similar study of the total material of twelve consecutive years and on which a vast amount of personal effort, time and money have been spent in the pursuit of results. Similar research emanating from other institutions would doubtless furnish surprises. We have been living in a fool's paradise of fallacious statistics.

If the results of surgery in one of the leading hospitals of the country and in the hands of surgeons of exceptional experience and skill are so bad, one must conclude that the average results of operation throughout the country must be at least as bad and in all probability considerably worse. After all, perhaps the laity have some ground for the pessimistic attitude about cancer which they still maintain in spite of all our efforts to dissipate it. Although roentgen rays and radium have been of great value in the treatment of cancer, especially superficial cancer, uterine cancer, and in the large field of inoperable cancer as a palliative measure, we are still lacking authoritative data upon which to base an opinion as to the actual curative value of radiation in deep-seated cancer in general, and as Dr. Gibson stated, it is time that a report of the results of radiotherapy, along the lines of his paper, was published.

One month after the publication of Dr. Gibson's paper, we find a report by Channing C. Simmons[3] on Cancer of the Mouth: The Results of Treatment by Operation and Radiation. This report was based on a study of 376 cases observed at the Massachusetts General and Collis P. Huntington Memorial Hospitals during the years 1918, 1919 and 1920. The term "cure" as applied to these cases means those that were alive and free from evidence of the disease for three or more years after treatment. In every case of "cure" by operation, the diagnosis was confirmed microscopically.

The results of 51 operations on primary cases that showed no clinical evidence of metastases are as follows: There was one operative death, a mortality of 2 per cent. Of 25 cases which showed metastases at the time of operation, two died as a result of operation, an operative mortality of 8 per cent and two were not traced. Incomplete operations were performed on ten cases with no cures, and a radical operation was performed on 13, with one cure.

Relative to the results following radiation, in 27 primary cases that showed no evidence of metastases, there were four "cures" (15 per cent). Simmons states:

> No pathological examination was made in any of the cured cases. All were of the papillary type and originated in areas of leucoplakia, and the diagnosis of malignancy is open to question. One had a distinct indurated area and was undoubtedly malignant. The other three cases received many radium treatments for recurring areas of papilloma and leucoplakia over a long period of time. One hundred and eight primary cases in which the glands were clinically malignant were treated by radiation. There were no cures. It is perhaps hardly fair to consider all of these 108 cases comparable to the 25 in the corresponding group treated by operation.

Simmons has tabulated his cases as follows:

RESULTS OF OPERATIONS (45 CASES) IN PRIMARY CASES WITHOUT CLINICAL METASTASES

	Dead	3 Year Cures	Per Cent Cures
Tongue	15	4	26
Floor	3	1	25
Cheek	2	4	66
Upper jaw	4	4	50
Lower jaw	4	3	43
Tonsil	1	0	1
Totals	29	16	34.7

"Cures" following radical operation..... 35 per cent.
"Cures" following incomplete operation.. 34 per cent.
Operative mortality (1 case in 51 operations) 2 per cent.

In brief, there were only 20 three-year cures in a total of 376 cases treated (16 treated by surgery and 4 treated by radium).

Comparing these two similar groups of cases, the first treated by operation and the second by radiation, it is seen that in primary cases of cancer of the mouth without evidence of metastases, surgical treatment offers 35 per cent chances of cure, the operative deaths being classed as failures, against at best 15 per cent of cures following radiation treatment. In primary cases with evidence of metastases radiation treatment offers no chance of cure and operation not over 5 per cent.

Among the conclusions reached by Simmons are the following:

1. Cancer of the buccal mucosa is a rapidly growing form of carcinoma and is often incurable in a few months from the onset of the disease.

2. Of the primary cases dying of a recurrence of the disease, life is prolonged by treatment, but the patient lives longer following operative treatment than following radiation treatment.

3. In recurrent cases dying of the disease in all groups, life is longer in the cases which received radiation treatment than in those cases receiving no treatment.

4. A certain group of cases which may be said to have been "cured" by treatment are prone to develop a second cancer at some other point in the buccal mucosa.

These results are of especial importance inasmuch as they represent a large group of cases in the hands of men of exceptional knowledge of modern methods of treating cancer and unusual skill in the application of these methods.

Dr. William C. Clarke of New York, Professor of Experimental Surgery, Columbia University, in a most illuminating address on Common Surgical Procedures; Their Scientific Status in Cancer, delivered before the Brooklyn Pathological Society, October 8, 1925, reviews the end results in 420 cases of cancer of the breast operated upon at the Presbyterian Hospital, New York, from 1910 to 1924.

Clarke laments the fact that while knowledge in the pure sciences rests for the most part upon a strong scientific basis, this is hardly true in medicine. He believes that fixed habit of thought, custom and superstition are numbered among the chief hindrances to progress in clinical medicine and surgery, and that the present procedure in the treatment of cancer is following the pathway of habit. In regard to the treatment of cancer of the breast, he states:

> If you have a few patients alive ten years after operation, that by clinical and microscopic examinations were believed to be cancer cases, you are proud. If you have a couple more who have lived for fifteen years you are tickled to death. Few of you know of a patient who, after twenty years have elapsed, is apparently cured. This must mean that you are not so confident that your operation is doing much to help your cancer patients.

Of the 420 cases of cancer of the breast operated upon at the Presbyterian Hospital during the period mentioned, 135 cases were not followed and there were 11 operative deaths. Of the 264 traced cases, 100 or 42 per cent were alive (average postoperative life being fifty months) and 164 or 58 per cent were dead (average postoperative life, 24.3 months).

Of this series, one case has lived fifteen years (cancer of right breast; nine years later cancer in left breast), one, fourteen years; one, twelve years; two, eleven

years; and two, ten years. These seven patients were still alive and well in 1925.

Clarke states that today there is much propaganda published to persuade people to be operated upon at once on the discovery of a tumor, and for frequent physical examination to make the discovery earlier than in the past. He continues:

> At the same time much of this propaganda is misleading, the truth is hidden and distorted. The efforts of collecting the follow-up results on operations for cancer will be wasted unless comparisons are possible so that the whole truth may be known. It is true that there has been more intensive research work in cancer than in almost any other field of medicine, but will not these workers be more effective if they are not lulled into complacency believing that the operation for cancer is effective?
>
> I believe that the total good which accrues to all patients when all forms of cancer are considered is disappointingly small. I believe that operation makes the majority of cancer cases more comfortable for a period, and affords them a brief mental uplift, unfortunately counterbalanced by the almost inevitable reappearance of their growths. I believe that in a few cases the good is overwhelming; therefore, I believe all should be operated upon and as early as possible, until a better procedure be discovered or until it be discovered which cases should be operated upon and which should not be so treated.

The most serious attempt to ascertain the end results of the surgical treatment of cancer has been made by the British Ministry of Health, under the able direction of Sir George Newman. Reports of various workers are published from time to time. Among the most noteworthy of these are the reports of Dr. Janet E. Lane-Claypon[5] in which she reviews the literature on cancer of the breast and its surgical treatment. We believe that the American Society for the Control of Cancer might well follow the example of the British Ministry of Health, and attempt to get the end results of not only cases operated upon at the leading American hospitals but also those treated by radiation. It might be better still to follow Dr. Gibson's example and record the end results of treatment of all types of cancer of all localities rather than merely those of special organs.

That cancer is increasing at a most disturbing rate throughout the civilized world is now very generally admitted. For a time there was an attempt made to explain away this increase in various ways, one being the assumption that increased knowledge and greater skill in diagnosis in recent years have added many deaths to the cancer mortality which formerly were attributed to other causes. There is little ground for this theory for the reason that, while the diagnosis of cancer in the early stages of the diseases is often most difficult, the clinical signs of cancer in the ultimate stages are so clear that few physicians could mistake the disease for any other. Again, the increases in the mortality includes all types of cancer, those in the accessible regions where the disease could not be mistaken as well as those in the inaccessible regions where there might be a chance for error in the diagnosis. The theory that more people formerly died in infancy and youth before reaching the so-called cancer age fails to account for more than a small part of the increase in the disease. There has been the same increase in sarcoma which attacks at any age. Recent studies based on an analysis of patients who have reached the cancer age compared with a similar series of those observed at earlier periods show an unmistakable increase and leave us nothing upon which to base a hope that the increase in cancer is fancied rather than real.

Schereschewsky[6] of Boston makes a very interesting and important contribution to the statistics on cancer mortality in the ten original registration states.* According to him, the population aged forty years and over is the important age group so far as cancer mortality is con-

* Trend for the period 1900 to 1920.

cerned. In 1900, in the states under consideration,* this age group furnished about 89.8 per cent, and in 1920 about 92.5 per cent of all the cancer deaths. The population forty years and over of the ten original registration states was 5,313,459 in 1900, in 1920, 8,145,709.

Schereschewsky calls attention to the following table:

PERCENTAGE INCREASES IN DEATH RATE FROM CANCER OF ALL FORMS

	Death Rate per 100,000		Per Cent Increase
	1900	1920	
Cancer, all forms	212.0	311.4	46.9
Buccal cavity	5.5	11.18	103.4
Stomach and liver	77.1	116.2	50.7
Peritoneum, intestines and rectum	19.0	47.2	148.4
Female genital organs*	51.0	84.0	64.7
Breast*	34.4	62.8	82.6
Skin	7.36	9.38	27.4
Other organs or organs not specified	60.75	54.9	9.6 decrease

* Female population forty years and over.

According to Schereschewsky, even a casual examination of the mortality returns over a series of years shows that a pronounced change in the direction of greater precision and detail in the filling out of death certificates must have taken place. He states that while the general death rate in persons forty years and over has shown but little change during the period of observation, the death rate from "ill defined" causes fell during the twenty-one year period from 108 to 5, a decrease of more than 95 per cent. In similar fashion, the mortality rate from senility declined from 185.0 in 1900 to 39.1 in 1920, a decrease of nearly 87 per cent. Undoubtedly many of the cases classified as "ill defined" in later years were reported as cancer deaths.

Schereschewsky reaches the following conclusions:

1. There has been a pronounced increase in the observed death rate from cancer in persons forty years and over in that part of the United States known as the ten original registration states.

2. Part of this increase (about 30 per cent) is due to greater precision and accuracy in the filling out of death returns.

3. The remainder, however, is an actual increase in the mortality resulting in a death rate between 25 and 30 per cent higher than it was twenty-one years ago.

In discussing Schereschewsky's paper, Frederick L. Hoffman of Newark, N. J., stated:

Last year the rate for American cities was the highest on record, while for certain cities the rates are decidedly alarming. But the root of the matter will not be effectively dealt with until the rate is broken up into its component parts and we deal separately with the different forms and types of cancer that affect the human body. The cancer problem is unquestionably the greatest problem before the medical profession at the present time. It will certainly not be solved by those who spend their time in hair-splitting arguments, chiefly for the purpose of controversy, rather than in aid of the search for cancer facts. The statistical aspects of the cancer problem are extremely complex, burdensome, costly and always difficult, but the outstanding results of statistical research are unquestionably useful contributions to cancer knowledge and aid in the search for a better understanding of the true nature of malignant disease.

It is evident that the laity are becoming more and more interested in the control of cancer, and it might be worth while to consider for a moment some of their views on the subject. In a recent book entitled "Lay Sermons," Lady Margot Asquith[7] in discussing health devotes a brief paragraph to cancer. She states:

When you hear of cancer-houses, you ask about the drains, but it would be more to the purpose to ask about the drainage of the victims than of the building. We may be on the eve of a great scientific discovery in connection with cancer, but in the meantime little is known about it. It is a step forward to learn

* Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island and Vermont.

in what part of the world certain intestinal afflictions seldom occur, and it is possible that, if people were more observant and at an early stage of cancer could be influenced to tell men of science as much as they could of their diet and habits, it would be more valuable than all the experiments made upon rats and rabbits.

Sir Arbuthnot Lane[8] believes that cancer is largely due to the absorption of intestinal poisons caused by constipation, which would account for the relatively low incidence of cancer in India where the natives live almost exclusively on a vegetable diet and where constipation is almost unknown. While this may be a partial explanation and true as far as it goes, it in no way conflicts with the theory that cancer may be due to a microorganism which finds an unfavorable soil for development in persons living upon a simple vegetable diet, and a highly favorable soil in the tissues of persons living on the richer and more highly proteid diet with greatly increased consumption of salt and sugar of Western civilization. In any event we believe the health campaign inaugurated by Sir Arbuthnot Lane to be of the utmost value in so far as it succeeds in getting a more general adoption of a simpler and more rational diet. This would undoubtedly lead to improvement in general health, and it is not impossible that there would be some improvement in the cancer mortality as well.

In a bulletin issued by the American Society for the Control of Cancer, at the time of the Mohonk conference, September, 1926, it was stated that nothing less than the utmost authoritative and most reliable opinion will suffice to meet the pessimistic attitude of many people who think that cancer is contagious, hereditary and infectious. We note, however, since the recent publication of Maud Slye's[9] elaborate investigations carried on over a period of many years and demonstrating definitely that cancer is hereditary in animals at least, that the earlier views held by the Society have been modified to some extent, and that they now incline to the attitude that while human beings may not definitely inherit cancer one may at least inherit a greater susceptibility to the disease which amounts to very nearly the same thing. In the light of recent investigations I believe that the views of the Society in regard to the infectious origin of the disease may also have to be modified.

The geographical distribution of cancer, its widely different incidence in comparatively near localities, its low incidence in places where the death rate from tuberculosis is abnormally high and where malaria is usually prevalent all point to an infectious origin of cancer. Its great rarity in countries like India and the tropical portions of Africa also may be best explained on the assumption of an infectious origin of the disease. Its low mortality in these districts may be due to a number of factors, for example, (1) if infectious, the cause may be less common in these localities or (2) these people, whose ancestors have lived for more than a thousand years in the same locality with little or no migration and largely upon a simple vegetable diet with little salt or sugar, may have acquired a natural and inherited immunity to the organism, which immunity is gradually lost by the adoption of the habits and diet of Western civilization. This theory is still further supported by the fact that the natives of these countries have acquired an almost complete immunity to appendicitis and gastric and duodenal ulcer, all of which are due to infectious causes, and this same immunity is lost on the adoption of the diet of Europeans.

Those who have had the largest clinical experience with the various forms of malignant tumors cannot fail to be impressed by the close resemblance between malignant tumors and swellings known to be of infectious origin, for example, Hodgkin's disease, tuberculosis and syphilitic tumors. I have observed numerous cases in which the most experienced

pathologists were unable to differentiate these conditions. Hodgkin's disease is now classified by most pathologists as infectious granuloma and not a neoplasm at all, and yet, lymphosarcoma, which is often impossible to distinguish from Hodgkin's disease, is still classified by most pathologists as a neoplasm, although many have begun to place it among the malignant granulomata. If, then, malignant tumors so closely resemble conditions which are accepted as of infectious origin, is it unreasonable to assume that the tumors still classed as neoplasms may not likewise be due to some unknown infectious cause?

Broussais[10] was one of the earliest and strongest advocates of the idea that tumors are closely related to chronic inflammation, and this view was largely accepted by Virchow,[11] as well as by Jonathan Hutchinson,[12] who said:

> The propositions in reference to cancer, which I am chiefly concerned to maintain, are: First, that it is a modification of chronic inflammation, and that the same laws which are applicable to the one are, for the most part, applicable to the other. Second, that it is under the influence of inherited tendency and of senility, that processes inflammatory in their outset tend to pass into those of cancer. Third, that cancerous processes are in their initiation local, and that the disease becomes constitutional by infection, by elements derived from the primary growth.

Roger Williams[13] makes a very elaborate attempt to disprove the theory of the microbic or infectious origin of cancer, and quotes Billroth:[14]

> A tumour is a neoplasm that has not started from the same causes as excite inflammation, but from others that are unknown, or but vaguely suspected.

Williams continues:

> I think I have already made it sufficiently plain both in this and in other chapters, that my views on this important matter are entirely in accord with those of Müller, Billroth and Cohnhein; indeed, I believe that the Broussaisian doctrine of tumour formation is mainly responsible for the comparatively small progress that has been made during the last half-century in tumour pathogeny—this misconception having given a wrong bent to the direction of tumour research . . . For, since inflammation is the outcome solely of extrinsic causes, whereas the causes which determine tumour growth are mainly intrinsic, it is obvious that of these divergent and incompatible ways, only one can be right.

Williams' statement that "the causes which determine tumour growth are mainly intrinsic" is purely begging the question. During the last twenty years, this intrinsic theory has more or less dominated the field of cancer research, and yet have we seen any greater progress in tumor pathology during this period than previously when the theory of the extrinsic origin of cancer held greater vogue? I believe, however, that a reactionary tendency is now noticeable, and that many men engaged in cancer research, especially in clinical cancer research, are again asking if it is not possible that the extrinsic theory may be the key to the hitherto unsolved problem of the origin of cancer. Numerous objections to this theory are still recognized, and yet I believe it is possible to answer most of these objections.

Willy Meyer[15] of New York has stated:

> In years past I, also, belonged to the contingent of surgeons who believe in a specific agent of cancer, and hoped it would ultimately be found. Conditions in the latter part of the last century were especially favorable to the fostering of such expectations; it was a time when the discovery of the specific agents of many diseases was the overshadowing event in medicine. We knew then not quite so much of cancer as we do now, and the demonstration of its specific agent appeared in those days not only plausible but also most desirable, because seemingly it would have simplified matters.
>
> Moreover, surgeons gravitated naturally to such an expectation by reason of the many instances in which they came upon cases of the most rapid development of numberless metastatic foci, e.g., in miliary carcinosis of the peritoneal cavity where, macroscopically, the

symptoms make it next to impossible to regard the condition as other than infectious. Such experiences made them rather tenacious of their standpoint. But something happened that set me thinking. Ten years ago, when Aschoff was here, I asked him whether he shared Klemperer's[16] just then publicly expressed hope for the ultimate discovery of the specific cancer agent. He replied: "And if you should reach Methuselah's age, you would not have lived long enough to see that happen."

According to Meyer, "no analogy exists between cancer and any known form of infectious or contagious disease. The possibility of transference of cancer cells from one individual to another is non-existent." We know that it is possible to transform cancer cells from one animal to another, and were we permitted to experiment on human beings, no doubt the same would prove true in man. However, it has been frequently pointed out by Sir James Paget[17] and many other clinicians since his day that there is a very close analogy between cancer and other infectious diseases, e.g., tuberculosis and syphilis. This analogy is based not only upon clinical evidence but in many cases microscopical as well, for frequently it is most difficult for the pathologists to differentiate certain tumors of tuberculosis from malignant tumors; the same is true of syphilis. In my own experience, I have observed a patient who had been operated upon for a tumor of the testis. A microscopical examination was made by a professor of pathology of one of the New York medical schools, who pronounced it to be tuberculosis of the testis. When the patient came to me about six months later, he had a large retroperitoneal sarcoma which caused death within a year. In another case that was under my care for a rapidly growing tumor of the scalp, a large-size portion of the tumor was removed and on microscopical examination was reported to be chronic inflammation, probably luetic. This report was made by two professors of pathology of leading medical schools. The clinical progress of the tumor, rapid increase in size with later metastases, proved it to be a highly malignant sarcoma. These two cases are only a few that might be cited to prove that malignant tumors do have some analogy to tumors of known infectious origin.

Now let us consider another point raised by Dr. Meyer,[15] that is, "that the transference of cancer cells from one individual to another is non-existent."

In the *Annales d'Anatomie Pathologique* Lecène and Lacassagne[18] reported a remarkable case which I believe furnishes the evidence long sought in favor of the theory that malignant tumors may be due to a microorganism or an infectious virus of some sort. They describe their case as follows:

In early February, 1923, a medical student, aged twenty-one years, wounded himself with a hypodermic needle while attempting to draw off a collection of lymph from under the scar of an amputated breast, the operation having been performed eleven days before for cancer. (The disease had already involved the mammary gland and the patient died a few months later.) While the student was aspirating, the patient made a sudden movement of the arm; the syringe fell from the hands of the student, and in trying to catch it, the needle penetrated deeply into the palm of his left hand, at the same time discharging a small quantity of the liquid that was in the syringe. This is the beginning of a very remarkable observation. In three quarters of an hour, the student cauterized the track of the wound with a galvanic current. There was slight limitation of the movements of the fingers for several days but no real pain, and the accident was forgotten for a period of two years. In February, 1925, or two years after the puncture, he began to have diffuse pains in the whole hand; these were especially severe at night. Shortly after he noticed a hard, bosselated swelling at the exact site of the puncture, and along the track of the puncture. In March an enlarged gland the size of a nut appeared in the axilla. This was diagnosed as a tubercular gland as he had had enlarged cervical glands in childhood. The gland was removed and examined but no evidence of tuberculosis was found; it was regarded as chronic inflammation. In

reality, the gland was already invaded by a malignant process, originating in the punctured hand. In June, 1925, the swelling of hand became stationary. In July, the skin became invaded and thereafter ulcerated. On August 4th, under ether anesthesia, the tumor of the hand was excised, in view of the previous report on the gland process which was believed to be inflammatory or tubercular. A local recurrence developed and grew rapidly, and there was no longer any doubt of the malignant nature of the condition.

By September 15th, four nodules had appeared in the skin of the forearm, showing a generalization of the process. On September 23, the arm was removed by disarticulation at the shoulder, with complete dissection of the axillary glands.

A careful histological examination was made by Dr. Horrenschmidt, who examined (1) the axillary glands removed in April, 1925, (2) the primary tumor of the hand removed in August, 1925, (3) the nodules of the skin of the forearm, (4) the recurrent tumor of the hand and (5) the glands of the axilla removed on September 23, 1925. All these specimens showed the same general structure and were identical with the primary tumor of the hand which was diagnosed as a spindle cell sarcoma. The histology of the tumor of the breast from which the serum was obtained was that of an atypical carcinoma.

Lecène and Lacassagne stated that several hypotheses were offered in explanation of this case:

A. The possibility that there was a transmissionary graft of cancer cells, which had been cultivated in the collection of serum and introduced into the operator's hand by the needle puncture. In explanation of the change from one variety of cancer to another, the following were offered:

1. The tumor of the hand was an actual sarcoma that had undergone transformation from epithelial cells—a phenomenon that has been observed by Ehrlich and Apolant in certain grafts in rats.

2. The tumor of the hand was in reality an externally atypical epithelioma which had the histological characteristics of a sarcoma, brought about by developing upon new soil.

B. That the transmission of cancer is accomplished by the inoculation of a virus analogous to the filtrable virus admitted by Gye, possibly of an infectious principle analogous to that admitted by Garrel. The change in the histology of the type of the tumor is entirely "conciliable" with this hypothesis.

C. That there was no transmission of cancer at all but the development of a malignant tumor du novo at the site of the wound was caused by the hypodermic needle and the cauterization pathway.

The authors believe the last hypothesis to be quite inadmissible. Personally I believe the second hypothesis to be the most correct one.

Eight months later, Gye[19] of London published a new hypothesis on the etiology of malignant tumors which created worldwide interest. In brief, he claimed that the cause of malignant tumors in both man and the lower animals is a microorganism which is filtrable and cultivatable on proper media, and is visible by means of a specially constructed microscope, but which by treatment with a solution of chloroform may become incapable of producing malignant tumors unless the resistance of the tissues of the host is lowered by the introduction of some other cellular product or agent characterized as a "chemical stimulant" or "specific factor." In other words, he held that the microscopic agent or virus of the Rous chicken sarcoma which had been passed through a Berkefeld filter and had been devitalized by chloroform to such an extent that its power to produce tumors on inoculation had been completely abolished, by the addition of some special agent or "specific factor" could be reactivated and have restored to it its power to produce tumors on inoculation.

Other independent investigators who have failed to obtain the same results as Gye explain their failure on the ground that some of the living organisms have passed through the Berkefeld filter and that the amount of chloroform used was insufficient to completely destroy these organisms, and that the tumors which Gye succeeded in producing by this

filtrated and treated culture had their origin in these living organisms and were not the result of any particular action of a "specific factor."

Even if Gye's theory should prove incorrect—and thus far the evidence presented by other investigators has failed to fully confirm it—it would not mean that his work had been in vain. The idea behind his hypothesis still remains the most plausible explanation of the etiology of cancer. The idea of a "specific factor" or agent coincides in an almost uncanny way with our present meager knowledge of the etiology of malignant tumors.

At a symposium on cancer (Clinical Congress of American College of Surgeons, New York, October 20–26, 1924) with reference to the etiology of the disease, I stated[20]:

> If we assume an extrinsic origin of cancer, it is easy to understand that this organism may be very widely distributed over the world, that everybody is exposed to it, and yet that it requires a soil peculiarly fitted for it to obtain a firm hold in man and to produce a cancer. I do not believe that the question of favorable soil has ever received due recognition in discussion on the etiology of cancer. During the World War the Imperial Cancer Research Society of Great Britain had the members of its staff devote their entire time to the study of infections, abandoning for the time their research work in the field of cancer. A most important paper on The Mechanism of Bacterial Infections, with Special Reference to Gas Gangrene by two of these workers, Bullock and Cramer,[21] appeared in 1919. In it they state that very many wounds, especially those received on the Western front, were infected with Bacillus welchii, but only a very small percentage of those infected wounds developed gas gangrene. The same thing was found to be true in animals; of some hundred mice and guinea pigs injected with Bacillus tetanus only 2 per cent contracted the disease. It was found, however, that doses of 2.5 mg. of calcium chloride, when injected subcutaneously into mice of 10 to 15 gm. weight, together with a suspension of a virulent strain of Bacillus welchii or *vibrion septique*, will produce a violent gas gangrene in every case.

The assumption is that a malignant tumor is due to a microorganism, e.g., an organism somewhat similar to the virus of a Rous sarcoma, and that this agent is ordinarily of such a low degree of virulence that the normal body cells are sufficiently resistant to prevent it from producing a malignant tumor until in some way another quite independent factor is brought into play corresponding to the "specific factor" of Gye, which, either by lowering the resistance of the body cells or increasing the virulence of the organism, makes possible the production of a malignant tumor. This other agent may vary widely in character; it may be some form of chronic irritation which, by lowering the vitality of the cells, makes it possible for the infectious agent to obtain a foothold and start a proliferation of cells which later results in a malignant tumor. On the other hand, this agent may be a single trauma causing some hemorrhage or some slight bruising of the tissues which in some way destroys the delicate equilibrium of the cells and thereby furnishes suitable soil for the development of a malignant organism. Or again this agent may be some chemical change in the body fluids brought about by a change of diet, which may act as a specific factor.

As stated before, the lack of complete confirmation of Gye's laboratory experiments does not materially weaken the theory presented. Perhaps he tried to prove too much. In dealing with the problem of human cancer we do not need to go as far as to assume that the microbic agent is actually destroyed but that it is simply reduced in virulence. We need only assume that the body cells normally have such a high degree of resistance to the infection that it is harmless until this resistance is broken down by some of the factors mentioned. We may never be able to produce in the laboratory the exact conditions that obtain in the human body, but from what we do know of the possibility of breaking down the resistance

of certain microorganisms by simple chemical changes in the body fluids, it is quite permissible to assume that similar changes may be brought about in the development of malignant tumors.

It must be conceded at the beginning that the supposed microorganism that is assumed to be the cause of cancer differs from all known types and must not be judged by the same criteria. It should be permissible to assume that we are dealing with an infectious agent that differs from any of the more common types of infection, and that the clinical manifestations or tumors produced by this agent may differ materially from ordinary inflammatory conditions. We might be permitted, still further, to assume this agent to be ultramicroscopic, at least in certain stages of its development. Granting it were an intracellular organism would explain the hitherto unknown reason why a metastatic tumor of the liver in primary cancer of the rectum should show the same type of cells as the primary tumor instead of being made up of liver cells. We may even assume that a single microorganism may under certain conditions produce a proliferation of epithelium cells resulting in a squamous carcinoma in one case and in another, under different conditions, resulting in a lymphosarcoma. We know that the late Professor Erwin H. Smith[22] of the Bureau of Plant Pathology, Washington, by varying the site and depth of his inoculations, was able by the use of a single microorganism to produce different types of malignant tumors in plants.

It is likewise possible to assume that we may be dealing with a certain closely allied group of organisms, morphologically perhaps very similar but producing widely different clinical manifestations, such as the different types of streptococcus which, though morphologically identical, clinically give rise to wholly different types of infections, such as erysipelas, scarlet fever and cellulitis.

We talk a great deal about chemical irritants and trauma as the principal exciting causes, and there is no doubt that they are the chief exciting causes, but behind these immediate and exciting causes there may lie, and, in my opinion, there certainly do lie, other and antecedent causes such as some obscure factor that lowers the natural resistance of the body cells to the causative agent, whatever it may be. If this causative agent should prove to be some form of infection, as many of us believe it to be, it is easy to understand the very marked variations in the geographical distribution of cancer which have never been satisfactorily explained on any other theory. It is well known that in certain native races cancer is so rare that it is almost unknown, and further and more important, it has been stated by Sir Arbuthnot Lane[8] and by surgeons who have lived in India for many years that the English residents there have the same high cancer mortality as that which obtains in England. Furthermore, and of exceeding interest and importance if true, it has been stated that Indian natives who adopt the habits and diet of the English likewise acquire the same high cancer mortality. While this statement has been questioned by some writers, it has been reaffirmed by others. In a recent letter to the editor of *The Lancet*, H. Hallilay[23] writes as follows:

> The population of Punjab consists of roughly 22,000,000 people. The immensely larger proportion of this population is concerned, either directly or indirectly, in the cultivation of the soil. Their diet consists of wholemeal bread and dal, varieties of pulses, with large quantities of cooked and uncooked vegetables, and many varieties of fruit. . . . Speaking as a surgeon who has practiced and lived amongst these people for the past twenty-five years, I can testify to the great rarity of such diseases as appendicitis, gastric and duodenal ulcer, gallstone disease and visceroptosis amongst them, and, finally, to the infrequency of cancer in any of its forms. I wish it to be understood that I am referring to the agricultural and pastoral tribes of the Punjab and not to the literate and clerical classes,

many of whose members have departed in a greater or less degree from the simple habits of their forefathers.

The most complete and authoritative proof of the fact that cancer is extremely rare in India and neighboring countries, particularly Ceylon, may be found in W. Roger Williams'[24] book on The Natural History of Cancer in the chapter on Geographical Distribution and Incidence. He states that, according to Davidson[25] cancer is very rare in Bombay, only 0.1 per 1,000 of the total deaths being due to this cause. Furthermore, that

> Among the natives of Ceylon, malignant tumours are very rare, the death-rate from this cause in 1897, being 5 per 100,000 inhabitants, or 1 in 563 of the total deaths . . . According to Sir A. Perry[26] the cancer mortality in 1903 was 1 in every 16,820 persons living, or about 6 per 100,000 inhabitants. The island is highly malarious.
>
> In Burmah and Siam, malignant tumours are perhaps rather more prevalent than in India. During four years' residence in Siam, Gowen[27] met with a few cases of carcinoma and sarcoma, but Rasch never saw a single case of sarcoma there.
>
> Among the Laos people, who occupy the region to the north of Siam, Hansen[28] found that malignant tumours were very rare. In three years' practice he met with only a single case.

Dalgetty[29] states that during his five years' work in Adampore in South Sylhet, among a laboring population of 12,000 Hindoos imported from various parts of India to work in the tea-gardens, he observed only eight cases of malignant disease. Six of these were cancer and two were sarcoma. Among 15,000 Mohammedans of the same region, but all of whom were resident natives rather than imported, only three cases of malignant tumor were observed in a period of five years.

Behla,[30] who for twenty-two years made a most careful study of the house incidence of all cancer deaths in Luckau (which has a stationary population of 5,000) found that about 1 in 25 of the total deaths were due to cancer. The most remarkable point brought out by his investigation is that in the central part of Luckau, which is low-lying and surrounded by ditches (comprising 3,000 inhabitants), there were 65 deaths from cancer, while in the eastern suburb, Kalau, which is also low-lying and marshy, being intersected by irrigation canals for market gardening (comprising 1,000 inhabitants) there were 73 cancer deaths, or 1 in 9 of its total mortality. It is very hard to imagine a sufficiently great variation in the mode of living and character of diet in people living in such close proximity to account for this great variation in mortality. In striking contrast with the foregoing, the high-lying and dry suburb of Sando (comprising 100 inhabitants) had not a single death from cancer during the whole period covered by Behla's study. It is extremely difficult to explain these striking variations in the death rate of cancer, but in my opinion, the facts just presented point almost conclusively to an infectious origin of cancer, and that this infectious agent is found more often and in more virulent forms in some localities than in others that may be so near as to be almost contiguous.

While Roger Williams[31] does not hesitate to report these and similar studies in full detail, he passes over them lightly in his final conclusion with this remark:

> As against these weighty considerations, the curious medley of chaotic and conflicting statements advanced by the advocates of infection in support of their thesis seem to me to be of little worth. We need not seriously entertain these fairy tales, until their great progenitor, the hypothetical microbe of cancer, has been discovered.

This is the very same argument that was used in connection with tuberculosis, which disease was regarded by the laity as infectious centuries before the tubercle bacillus was discovered by Koch.

Although most of these statistics are comparatively old, dating back twenty

years or more, they are practically all confirmed by the recent and most valuable work of Dr. Frederick L. Hoffman,[32] Consulting Statistician, The Prudential Insurance Company and Director of the San Francisco Cancer Survey. His paper on Cancer in Native Races contains a large amount of new and most important data on incidence of cancer in various countries.

With regard to Africa, he states:

According to *The Medical Journal of South Africa*, of April, 1925, Watkins Pitchford,[33] reporting upon cancer among natives in Natal and Zululand, remarks, "During the four years from 1906 to 1909, eight deaths from cancer were reported among the whole native population of 930,000, giving a crude death rate during the period of approximately 0.2 per 100,000 per annum. For the same period the average yearly death rate from cancer among the Indian immigrants was approximately 11.9 and among the Europeans 57.5. The native death rate per thousand from all causes was 13.2, which no doubt is an understatement. The cancers were of the breast, liver, stomach, male generative organs, while one was a sarcoma of the shoulder."

Mr. J. Ellis Barker[34] has brought together a considerable amount of valuable data on Cancer and the Black Man in an article contributed to the *Fortnightly Review* of March, 1925. It is work of this kind that is likely to prove valuable in the course of time. He emphasizes the point that "the key of the cancer mystery is to be found in the fact that cancer is a disease of civilization, that it is most prevalent in the most civilized nations, and that it is extremely rare in those primitive races which lead primitive lives."

Of particular value is a quotation from the *Zeitschrift für Krebsforschung* in which Dr. von Hansemann[35] describes the malignant tumor material which was sent from the German colonies to Germany for microscopic examination. "It is generally known that malignant epithelial tumors are almost completely absent in the case of uncivilized negroes. I have never seen a case of cancer among the negroes of Cameroon, and only four cases of sarcoma."

In 1924 I was favored with a report from Dr. A. J. Orenstein, Superintendent, Department of Sanitation of Rand Mines, Limited, Johannesburg, South Africa, who writes me in part as follows:

"It may be of interest to you to know that such cancer as we see among natives employed on the mines is carcinoma, and usually of the liver. In fact, Dr. Pirie has formed the opinion that bilharzia infection might have something to do with it. Another curious feature is that this carcinoma seems to attack natives in the third decade of life. . . . Perhaps I may express my personal opinion that so far as South African natives are concerned, carcinoma is not the unknown disease that some writers would lead us to believe.

"In their own villages the vast majority of natives live on the following staples: maize in the form of meal or as cooked grain; a certain amount of milk; various grasses and herbs, cooked; peanuts now and then; millet now and then; meat on infrequent occasions among most tribes, but when eaten it is usually consumed in large quantities at one sitting. One might almost say that meat eating partakes of the nature of an orgy.

"On the mines the daily ration consists of: maize meal, 24 ounces; bread (⅔ wheat, ⅓ maize), 6 ounces; beans or peas, 1½ ounces; meat, 8½ ounces; peanuts or fat, about 2 ounces; sugar, 1 ounce; salt, coffee or cocoa and usually kafir beer, about 6 ounces. . . . Canned provisions are not consumed as a regular ration on the mines, although the more civilized natives are rather fond of buying canned tomatoes and sardines, but these articles cannot by any means be said to constitute an important portion of the dietary."

Under date of January 5, 1924, the Chief Sanitation Officer, Dr. Paterson, of the Medical Department of Nyassaland, writes me from Nairobi:

"The most that can be said is that both sarcomata and carcinomata have been observed among the non-European populations, that the diagnosis has been confirmed by microscopical examination with regard to both classes of tumors and that both sarcomata and carcinomata would appear to be very much rarer among the native populations than among Europeans."

According to a statement in the *Annals of Tropical Medicine*, Liverpool, 1923, based on an article on Malignant Growths in West African Natives, by Adler and Cummings,[36] it has been alleged that malignant growths in West African natives are rare. Adler and

Cummings report seven cases; five of these occurred in aborigines and two in creoles. The tumors were melanotic sarcoma, epithelioma on scrotum, epithelioma of lip, meningeal sarcoma, primary carcinoma of the liver and secondary carcinoma of the liver.

This statement is of exceptional interest in that it supports the view that while cancer does occur among South African natives, broadly speaking, it is chiefly of a sarcomatic type or, if a carcinomata, affects the liver. The latter infections it is said are as a rule complicated by liver fluke which may be of direct parasitical origin. It is regrettable that the subject should not have been more carefully considered.

Of exceptional interest are the statistics of our native Indian population as now compiled annually by the Division of Vital Statistics of the United States Census. They are unfortunately limited to the Indian population of the registration states and concerned chiefly with Indian tribes more or less in contact with white civilization. They represent, however, approximately the mortality of an Indian population of about 100,000.

During the four years ending with 1924 there have been 214 deaths from cancer among this population in a total mortality of 8,851, equivalent to 2.4 per cent. In the normal white population the proportion of cancer deaths is approximately from 7 to 10 per cent. Out of 4,487 deaths of males, 74 or 1.6 per cent were from cancer, while out of 4,364 deaths of females, 140 or 3.2 per cent were from cancer.

If it is assumed that the aggregate population was approximately 350,000 during the period under review, this would give an approximate cancer death rate of 60 per 100,000. But as pointed out previously the fact must not be overlooked that the major portion of this population is in comparatively close contact with white civilization and has adopted largely the customs, manners and diet of white people.

A most important contribution to the subject of cancer death rate variations in relation to combustion, products of fuel, topography and population has very recently been made by Jerome Meyers,[37] of New York. The study covers not only different localities but even different districts in the same locality, and includes many valuable statistics on the cancer death rate in different parts of Europe as well as in the United States. The greatest value of this survey lies in the new and original data obtained in regard to the cancer death rate of the Borough of Richmond during the period of from 1914 to 1920 inclusive. All deaths from carcinoma, sarcoma or other malignant growths were individually noted by name, street and number, age, sex, nativity, birthplace of mother and father and length of residence on Staten Island. All cases that seemed of doubtful diagnosis, all that had died in institutions, all cases that could not show a residence on the island for a period of at least three years before the time of death were excluded. A total of 515 deaths at all ages from malignant diseases in the period mentioned (1914–1920) formed the basis of the survey.

Meyers states that in order to study the influence of topography on cancer incidence Staten Island was divided into thirteen districts, comprising a population of 100,000. It was found that the death rate in these districts varied from 42.1 per 100,000 to 78.9. In the elevated central part of the island, the death rate was found to be only 42.9, while in level ground districts backed by elevated, the rate was 69.6. The district showing the highest rate on the island lies in a distinct cup or depression surrounded toward the south and southeast by low-lying hills. According to Meyers, it is therefore not only exposed to smoke but presents a topographical condition making for increased death rates.

Among Meyers' conclusions are the following:

1. There is a marked and interesting variation in cancer death rates in different countries, within countries and states and probably even in different sections of cities.

2. There may be an etiological relation between the incidence of cancer and topography. Open level districts, of high or low altitude, show lower cancer rates than land in hollows or depressions or intersected by gullies, valleys, or lying against adjacent hills. Albany and San Francisco should make interesting studies.

3. There may be an etiological relation between the combustion products of coal and oil and cancer. Those sections of Staten Island exposed to smoke fumes and gases show a higher cancer death rate than those not so exposed. House-heating and chimney ventilation are also important, as gases and fumes from these sources may bear a relation to cancer incidence as found in our districts.

4. Whatever may be the possible errors in this study of a comparatively small number of cases (515), it cannot fail to show variations in cancer death rates even on an island thirteen and one-half by seven and three-fourth miles, divided into 13 districts, and these variations would seem in the light of our findings to bear a relation to etiological factors of fuel and topography. These conditions therefore would seem to be a part of the complex etiology of cancer.

The first things one naturally thinks of in comparing the diet of the people of such countries as England and America with that of the natives of India are (1) the former live largely on a meat diet, the latter on a vegetable diet, (2) the former consume a large and increasing amount of sugar while the latter use only a very small amount and (3) the former consume a much larger quantity of salt than do the native races of India or Africa. Salt is so scarce in the interior of Africa that it has been stated that many natives willingly sell themselves into slavery to be taken to the coast where they can get salt.

Recent experimental research work in Berlin and Vienna would seem to give some weight to the theory that possibly the steadily increasing quantity of sugar consumed by the people of the West might have some relation to the steadily increasing cancer incidence. According to Warburg, a Berlin chemist, animal cancers are nourished by the grape sugar content of the blood. Rona and Deutsch have recently demonstrated that similar proceedings take place in human beings suffering from cancer.

It is well recognized that in the presence of a hyperglycemia, pyogenic infections tend to spread with great rapidity and produce early septicemia unless radical surgical measures are adopted early.

The recent laboratory investigations of Sugiura and Benedict[38] on the influence of insufficient diets upon tumor recurrence and growth in rats and mice, are of great importance and strongly support the theory that diet may play an important role in the etiology of cancer. The conclusions reached by these authors are worthy of wide publicity. They are as follows:

1. Transplants of the Flexner-Jobling rat carcinoma in rats fed on a complete basic diet but limited in quantity to one-third of the normal food requirement survived less frequently and grew much more slowly than those of full-fed controls.

2. Underfeeding after engrafted cancerous grafts had well established themselves in hosts had no marked inhibitory effect upon the subsequent rate of tumor growth.

3. Prolonged postoperative insufficient feeding had a distinct influence upon the frequency of recurrences of spontaneous tumors in mice. About 73 per cent of the underfed mice were completely cured of the tumor. On the other hand only about 18 per cent of the normally-fed controls were free from tumors at the time of death.

4. The number of new primary tumors subsequently developed or metastases found at autopsy were less in the underfed animals than in the full-fed controls.

5. The interval between the operative removal of spontaneous tumors and the development of local recurrences was delayed and the subsequent rate of tumor growth was diminished in the insufficiently fed animals.

6. The average postoperative longevity in the underfed mice was one hundred and forty-two days against ninety-six days for the full-fed controls. The gain of forty-six days in the experimental animals corresponds to about three and eight-tenth years of a man's life.

In view of the evidence presented by recent research workers, I believe we are justified in assuming that some simple change in the chemistry of the blood brought about by a change in diet, such as a greatly increased amount of salt or sugar, might have a very material effect

in lowering an individual's resistance to the unknown infectious microorganism that may be the cause of cancer, just as by the addition of a little calcium chloride to the body fluids of normal animals it has been found possible to break down their resistance to the tetanus bacillus and other infections (gas bacillus or streptococcus) and produce a serious, fatal infection that, without such addition, would have been harmless. This theory may prove without foundation but there are enough facts to justify us in taking the trouble and expense necessary to prove or disprove it. Should it prove true we have a working basis; then we could find what kind of food destroys or weakens the natural immunity to cancer and so modify our diet as to increase our resistance to the disease. This would be a great step forward in the control of cancer. In addition to these investigations every effort should be made to discover the cause of cancer for until this is known we believe there can be no real control of the dread disease.

While it has long been recognized that cancer and tuberculosis seldom occur in the same individual, only comparatively recently has the fact been brought to attention that there is an extremely close relationship between the incidence of the two diseases, and that while the death rate of tuberculosis has been steadily declining there has been a corresponding increase in the mortality of cancer. The question naturally arises whether there is any causal connection between the two diseases or whether we are dealing with a mere coincidence. A most careful study of the subject has been made by Dr. Thomas Cherry[39] of Melbourne who states:

> A suggestive feature in recent reports on public health from many parts of the world is the steady decline in the number of deaths from tuberculosis and the equally steady advance of cancer. In the first English records, more than eighty years ago, this reciprocal movement was already apparent, but at that time cancer was quite unimportant as compared with phthisis. By 1855 the phthisis rate had fallen to 2600 per million, and the cancer rate had advanced to 320. The two rates are now about equal in England and Wales. The changes which have taken place in the past thirty years and the percentage reduction and increase in the respective rates in each five year period are as shown below.

MORTALITY RATES PER MILLION LIVING

Periods	Phthisis	Percentage Reduction	Cancer	Percentage Increase
1871–5	2217	....	445	
1876–80	2038	8 2	494	11.0
1881–5	1830	10.1	548	11.0
1886–90	1635	10.6	632	15.3
1891–5	1461	10.6	712	12.6
1896–1900	1323	9.4	800	12.3
1901–5	1218	8.0	867	8.4
1906–10	1106	8.4	939	8.3

The history of tuberculosis in England shows that it was very prevalent during the early part of last century. In some localities hardly a family could be found which was not affected with the "strumous disposition." After allowing for some exaggeration in such generalizations there can be little doubt that the high figures of all the early annual reports are fully justified. With the marked improvement in food supply and the slower amelioration of the other conditions, recovery from a definite attack of phthisis would become more common. In some cases a high degree of immunity might be developed without the occurrence of a recognized attack of phthisis. Let us suppose that frequent contact with tubercle bacilli develops powers of resistance in the individual and makes him more or less immune to the infectious cause of cancer. The same may be true in regard to the influence of the malarial organism.

Various writers on different occasions have mentioned incidentally the fact that malaria was extremely prevalent in the district under observation. In view of the known influence of the inhibitory action of other infections upon malignant tumors, e.g., the streptococcus of erysipelas, it would seem by no means impossible that the malarial organism through high temperature reactions and other changes in the blood might exert a similar inhibi-

tory influence upon cancer, if not sufficient to produce a marked effect upon the actual development of a malignant tumor, at least to the extent of producing an immunity to the disease in patients suffering from malaria.

While it is almost the universal rule for scientists to make light of popular beliefs, especially in the field of medicine, until they have been completely and satisfactorily explained scientifically, it is curious how many of these beliefs are proved true in the end. In an article entitled The Savage as Scientist, the author, "Fulahn,"[40] makes the following interesting observations:

> The discovery that general paralysis, a disease symptomized by the degeneration of the tissues of the spinal cord and brain, and hitherto regarded as incurable, can be cured by inoculating sufferers with malaria, has been hailed as one of the most remarkable triumphs of medical research since Sir Ronald Ross, thirty years ago, discovered the connection between malaria and mosquitoes.
>
> Yet more than four hundred years ago witch doctors in the kraals of one Kitandu, then metmi or chief medicine man of the Iramba tribe, a peaceful pastoral race of savages who, to this day, live on the Daua Plateau in Tanganyika, had not only discovered that malaria was a cure for general paralysis, but they were prescribing mosquito-bite as a medicine for paralytic patients in exactly the same manner as Harley Street specialists are doing in this twentieth century of progress and enlightment.
>
> Harley Street, having no malarial swamp at its door, brings mosquitoes to its patients. The witch doctors of the Iramba send their patients to the mosquitoes. Otherwise the treatment does not vary a hair's-breadth!
>
> So that, when medicine man Mgendu urged Chief Kinga to move from Mandi on the plateau down to Sekenke in the plains and then afterwards to eat bitter roots, that half-naked savage doctor was prescribing the most up-to-date medical treatment for paralysis, based on the most recent discoveries of medical science.
>
> Mandi on the plateau, being 5,000-odd feet above sea level, is practically free from mosquitoes and malaria; but Sekenke, 2,000 feet lower down in the plains, stands in the middle of a swamp, and is one of the worst malarial districts in all Africa. At Sekenke Chief Kinga could not fail to get bitten by mosquitoes, to contract malaria, the germs of which would fight with the germs of his paralysis; then he could eat bitter roots, in other words, "a few doses of quinine."

My conclusions in brief are as follows:

1. Every means, similar to those already adopted by the American Society for the Control of Cancer, should be employed to encourage early recognition of malignant tumors as well as prompt and proper treatment of them. This entails not only continuous propaganda to persuade the patient to consult a physician as soon as a tumor is discovered, but, and what is more important, entails greater effort in educating physicians in the difficult field of the diagnosis of malignant tumors.

1. A considerable portion of the funds raised for cancer control should be expended in the field of collecting more facts, especially more accurate first-hand information as to the geographical distribution of cancer, and especially data that may account for the wide variation in incidence.

3. Cancer research, both clinical and laboratory, should be encouraged in every possible way, by grants if necessary to certain selected hospitals and laboratories. I believe it far better to give such grants or financial assistance to institutions already founded and possessing clinical and laboratory staffs that it has taken years to gather together and train than to attempt to start new institutions.

4. I believe that the work of Gye along the lines of the infectious nature of cancer should receive further and intensive investigation, since it is along these lines that the only real hope of ever obtaining efficient control of cancer lies.

5. A systematic attempt should be made to obtain a thorough follow-up of all patients treated for malignant disease in the leading hospitals of the world, and the end results should be published, thereby giving the public and the profes-

sion some definite ideas of the percentage of malignant tumors that are actually cured or, at least, well for a period of five years. Such information is lacking except in some special fields of cancer treated by men of exceptional experience and skill.

6. Little advance may be expected in the surgical treatment of cancer, but in the field of roentgen ray and radium I believe that, with increasing knowledge of the action of these agents and with improved technique, considerable advance may be anticipated. It is not improbable that in special fields, e.g., cancer of the cervix, radium may soon become the method of choice as it has already become in superficial and skin cancer.

7. A further study of the treatment of inoperable tumors, especially sarcoma, by bacterial toxins should be carried out. If it is found that a considerable number of these cases beyond hope from any other method of treatment can be cured by toxin treatment, and that in many operable cases in which the toxins have been used as a prophylactic after operation, a larger percentage of patients have remained well for five years, then this method should receive more general adoption.

8. The unpublished work of Torrey and Kann on the treatment of tumors with bacterial proteolytic ferments (to be read at the forthcoming meeting of the American Cancer Research Society), carried out under the auspices of Huntington Fund for Cancer Research and the Cornell laboratories, shows the bacterial treatment of tumors to be a very promising field for cancer research and one that has by no means received the attention it deserves.

9. The results of study by these various organizations and individuals working on the cancer problem, including both the clinical and laboratory aspects, should be given wide publicity. At least every three years there should be an international cancer congress, bringing together the leading workers in cancer and furnishing an opportunity for an interchange of ideas.

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ERRATUM

In "The Surgery of Pain," by Drs. William Francis Honan and Samuel Alcott Thompsons which appeared in the May, 1928, issue of the Journal, the legend appearing below Figures 1 and 2 should have been placed below Figures 3 and 4 and the legend appearing below Figure, 3 and 4 should been placed below Figures 1 and 2.

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[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

OBSTETRICS ONE HUNDRED YEARS AGO

A REPORT OF 500 CASES RECORDED FROM 1809 TO 1825 COMPARED WITH A RECENT SERIES

EVERETT M. HAWKS, M.D., AND EDWARD H. DENNEN, M.D., F.A.C.S.

NEW YORK

FROM 1809 to 1825 there was a lying-in ward in the New York Hospital. After several changes this old service evolved into the Obstetrical Division of the New York Nursery and Child's Hospital.

In the record room of the New York Hospital there is a well-preserved book in which the obstetrical cases were registered consecutively. These cases were tabulated under various headings and in the column under "Remarks" many interesting notes were made (Figs. 1, 2 and 3). This record is so complete and its reading so fascinating that it is well worth publishing. It is probably the oldest and best record of early obstetrics in this country. These cases have been grouped and the notes transcribed verbatim to preserve their character. Comparison has been made with the work done at the New York Nursery and Child's Hospital during 1927.

During these seventeen years from 1809 to 1825, 508 cases were admitted and 469 of them delivered. These cases were referred to the hospital by "The Visiting Committee" and were truly indigent. Most of the 38 cases not delivered were discharged "by request" and a note on one such case explained that

"By the elopement of a drunken husband this woman was compelled to seek refuge in this house and now by the return of the same vagabond she is compelled to leave it undelivered."

So probably in those days the women went to the hospital for confinement only when they had no home. However, the following note on another case shows that the advantage of the hospital was recognized.

CASE 450. "In this case the waters had come away on the evening of the 8th. The physician who was called in had attempted turning but in vain. She was therefore sent to the hospital on the 9th about noon . . ."

MORTALITY

The maternal and fetal mortality figures are surprisingly low despite there being no knowledge of infection, no prenatal care, no nursing, very little operative aid, and in fact none of the present refinements. There is much evidence of nice judgment and conscientious effort. The house physician's devotion is illustrated in Case 111, one of long labor. The note reads:

"Labour continued 72 hrs.—hard time for Charley (Dr. Chas. D. W. Hasbrouck)—could not go out on the 4th."

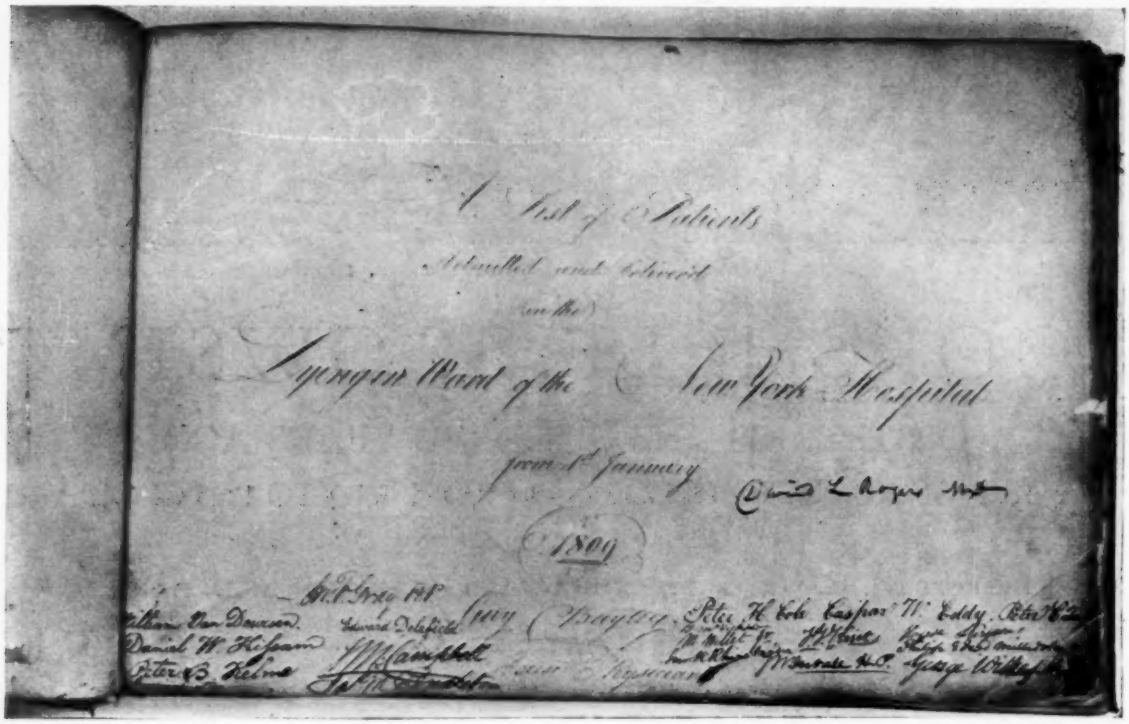

Fig. 1. Title page, showing signatures of the house physicians.

Fig. 2. First page, showing arrangement of the cases.

Fig. 3. Page showing additional columns and "remarks."

The case was admitted July 4, 1813 and delivered July 6th.

MATERNAL MORTALITY

There were twelve maternal deaths (2.5 per cent). In 1927 at the New York Nursery and Child's Hospital, over one hundred years later, there were six deaths in 2,425 cases (0.247 per cent). It is interesting to note that the last twelve deaths on the same service occurred in 4,646 cases during the years 1926 and 1927. It is also interesting to compare the causes of death.

OLD SERIES (1809–1825)

Puerperal fever, 6 cases.

Convulsions, 2 cases; one complicated by cough, probably pneumonia.

Abscess of liver, 1 case (present before delivery).

Fever and delirium, 1 case (onset twelve hours before delivery).

Cause not stated, 2 cases; probably sepsis.

RECENT SERIES (1926–1927)

Pernicious vomiting, 1 case (five months undelivered).

Pneumonia, lobar, 1 case (following cesarean section).

Peritonitis, 3 cases (one due to sloughing fibroid, two following puerperal infection).

Meningitis, 3 cases (two tuberculous, one following old otitis media).

Rupture of uterus, 1 case (following version and extraction).

Fractured skull, 1 case (jumped from fourth story window).

Mesenteric thrombosis with ileus (non infective), 1 case.

Postoperative hemorrhage, 1 case (from varicosities of broad ligament following cesarean).

The original case reports of the deaths in the old series were as follows:

1. Case 141. "Transferred from the Medical Dept. . . . After delivery her symptoms continued to increase until death (delivered June 28, 1814, died July 2, 1814). She was examined. An abscess in the left lobe of the liver was discovered which contained about a pint and a half of yellowish green matter. Find her case at large in the medical case books. The child was transferred to the Alms House and died two days after."

2. Case 167. "About 12 hr. previous to delivery this person was attacked with fever and delirium which continued during the whole period of labour. She died with apoplectic symptoms about 24 hr. after the birth of the child."

3. Case 189. "Dead." No notes. Aged twenty-six. Delivered April 5, 1815, died April 13, 1815.

4. Case 192. "Dead." No notes. Aged twenty-one. Delivered March 24, 1816, died March 27, 1816.

5. Case 220. Aged thirty; first child. "This patient died four days after delivery of puerperal fever. On examination the uterus was found slightly inflamed and its inner surface lined with coagulating lymph." Died, December 3, 1816.

6. Case 225. Aged eighteen, first child. "This patient died of puerperal fever five days after delivery," December 16, 1816.

7. Case 276. Aged twenty, first child. Delivered February 8, 1818. "This patient was attacked with puerperal fever on the 13th and died in the typhoid state nineteen days after delivery. The child lived but a few days and died of convulsions."

8. Case 350. "Born in France, aged 20 years, was taken in labour of her first child at 9 o'clock P.M. of the 1st December, 1819. On examination the os uteri was found dilating and the head presenting at the upper aperture of the pelvis. Her pains were frequent and shortly became violent and continued to recur at short intervals till 11 A.M. of the 2nd when perceiving her face flushed, her pulse strong and full & she complaining of indistinctness of vision at the return of every pain she was bled to 14 oz. with relief to the above symptoms—in ¾ of an hour she was attached with convulsions. She lay upon her back—her teeth clenched upon her tongue, her face and neck turgid with blood & of a purple colour. The pupils of her eyes dilated to their full extent & her features shockingly distorted. Her temporal artery & a vein in her arm were immediately opened. She bled freely from both and after the loss of about 30 oz., of blood partially recovered from the first attack—which was quickly followed by a 2nd & 3rd attended with more convulsive action & distortion of countenance than the 1st. The blood was permitted to

flow freely from both orifices & a common injection thrown up the rectum—which was repeated 3 times without effect. She was now immersed in a warm bath and suffered to remain in it for 15 to 20 minutes. She now became quite easy—her pupils contracted to their natural size and she continued to doze for 20 or 30 minutes. Previously to going into the bath & while in it she took about 2 drachms Tinct. Opii when she had another distinct convulsion. The other temporal artery was opened and the blood allowed to flow freely. The head had now advanced near enough to the external orifice to admit the use of the forceps & as labour had been for some time stationary and the contractions of the uterus seemed unequal to delivery but merely sufficient to excite convulsion it was determined to proceed to instrumental delivery as the last means of safety to the woman. Dr. Tappen applied the forceps and after the exertion of some force succeeded in delivering her of an uncommonly large dead child. In the course of an hour the placenta came away & she passed a comfortable night. She did extremely well till the 17th Dec. when she was attacked with cough & expectoration which increased rapidly and on the 25th terminated her existence in Ward No. 6 whither she had been transferred a short time before."

9. Case 354. "Sally Ann Martin—age 30 was attacked at the commencement of labour with convulsions. She was immediately bled to 30 Oz., from the arm and temporal artery which relieved her from the first attack. The second convulsion subsided after the loss of XV Oz., more of blood. On examination found the os tincae beginning to dilate. She now took 15 gr. Calomel & had a cathartic enema administered which operated freely—15th hour had another convulsion more violent than the preceeding from which she recovered after the loss of 24 Oz., of blood from the temporal artery. She now took in divided doses 2 drachms Tinct. Opii and remained free from convulsions for about 10 hours, when she had another slight attack. The os uteri was now considerably dilated and the membranes beginning to protrude. 1 drachm Tinct. Opii was now administered. At the 30th hour she was delivered of a female child apparently dead but which was resuscitated by immersion in the hot bath & the performance of artificial respiration. A bandage was applied to the abdomen of the woman who now lay in a comatose state. The placenta came away in about an hour—sinapisms were applied to her feet and an injection administered—her breathing became stertorous—her pupils contracted & she could not be sufficiently aroused to swallow anything. She remained in this state for 8 or 10 hours (supposed effects of opium) when she was attacked with another convulsion which was quickly followed by two more. Dr. Watts now ordered her to be bled & 14 oz., blood were taken from her arm. Her head was shaved and cloths wet in snow water constantly applied. Sinapisms were applied to her chest & legs but without effect. She died at 10 P.M. of Jan. 17, 1820."

10. Case 358. "This woman received a fright about four weeks before delivery. On Monday, Feb. 7, 1820 at 11 P.M., she was awakened from her sleep by a sudden gush of water to which succeeded occasional uterine pains. On Tuesday at 9 P.M. she was delivered of an uncommonly large child, stillborn after suffering severe and almost incessant pains for eight hours. As soon as the breech and inferior extremities were delivered the arms were extricated and brought down—which prepared the way for the head—but this was resisted and could not be delivered short of 30 min., after all prudent means at extraction. She experienced much pain and distress through the night, notwithstanding she had taken a large anodyne. The placenta was left 14 hours and then it required to be taken away in consequence of flooding. On Wednesday evening she was seized with a severe rigor which lasted for 10 minutes. On Thursday pulse quick & small amounting to near 180 strokes in a minute—skin hot & dry—headache plus slight delirium—bowels costive—lochia profuse—but little pain in the hypogastric region—recession of milk—rigors recurring at irregular intervals followed by profuse perspiration. She died on Monday the 14th Feb. at 9 A.M. Treatment—The bowels were kept freely opened by salts, castor oil and calomel—aided by occasional enemata—skin relaxed by the Aq. Ammon. Acet. united with Mist. Efferves., and a liberal use of warm diluent drinks. Formentations were early applied to the region of the uterus and mammae and as soon as much pain and tenderness were evinced a blister applied to that part of the abdomen—room kept dark & quiet as possible: during each rigor she took plentifully of warm teas."

11, 12. Cases 506 and 507. "These women

died of puerperal fever accompanied with violent typhoid symptoms which resisted every medication that could be suggested."

Two autopsies were done in the old and four in the recent series.

FETAL AND NEONATAL MORTALITY

The total fetal and neonatal mortality was 41 or 8.7 per cent, tabulated as follows:

Still-births, 26	Normal, 21	Term, 21	
		Premature, 0	
	Abnormal, 5	Term, 5 (macerated)	
		Premature, 0	
Deaths, 15	Normal, 15	Term, 12	
		Premature, 3	
	Abnormal, 0	Term, 0	
		Premature, 0	

There were 26 still-births of which 5 were macerated. All were presumably at term as none were stated as being premature.

The fifteen neonatal deaths occurred from a few hours to fifteen days after birth. Nine died during the first week, two on the fifteenth day and three had no record of the length of life. Three babies were premature. The list of neonatal deaths may not be complete, as the condition of the baby on discharge of the mother was not mentioned in several cases. Ten babies were noted as sickly when discharged.

The causes of the still-births were

Breech presentation	9
Macerated	5
Version	1
Convulsions in mother	1
Long labor	1
Unknown and not stated	9

The causes of neonatal deaths were

Convulsions	2
Syphilis	2
Circulatory disturbance	1
Erysipelas	1
Prematurity	2
Not stated and unknown	7

Correcting the still-births and neonatal deaths to normal babies at term we find there were 33 or 7 per cent. (In 1927 there were 51 or 2.1 per cent.)

The total fetal and neonatal mortality in 1927 in 2,420 viable births (28 wks.) was 135 or 5.57 per cent. All deaths within thirty days are included.

Still-births, 77	Normal, 41	Term, 32	
		Premature, 9	
	Abnormal,* 36	Term, 13 (8 macerated, 5 monsters)	
		Premature, 23 (19 macerated, 4 monsters)	
Deaths, 58	Normal, 48	Term, 19	
		Premature, 29	
	Abnormal,* 10	Term, 9 (monsters)	
		Premature, 1 (monster)	

* 27 macerated and 19 monsters.

The larger percentage of abnormal and premature babies in the recent series is noticeable.

PRESENTATIONS

(No mention was made of position.)

"Head"	446
"Brow"	1
"Face"	1
"Transverse"	3
"Breech"	16
"Hand"	6
Not stated	5
	478 deliveries

Nine sets of twins.

PARITY

No record was kept of the parity in the first half of the series. In the last 254 cases 109 were primparae and 145 multiparae.

DELIVERIES

Spontaneous	474
Operative	4 (0.8 per cent)

During 1927 on the same service there were 1,015 operative deliveries in 2,420 births (41.57 per cent). These include cesarean sections, breech extractions, versions and forceps. (Many of the latter were elective.) Practically all the 2,420 viable births were carried on under anesthesia.

SEX

Males	225
Females	246
Not stated	7

OPERATIONS

There were no cesarean sections. In 1927 there were 65 cesarean sections, an incidence of 2.75 per cent.

There was one forceps delivery, done in the interest of the mother, in a case of eclampsia. The baby was presumably dead before the forceps were applied (vide Case 350 under maternal mortality). No mention is made of fetal heart or of craniotomy anywhere in the series. In 1927 the incidence of forceps was 34.2 per cent in 2,420 viable births.

There were two versions ("Turning").

Case 12. "Hand presentation—Dr. Seaman turned the child & delivered it—stillborn." Mother recovered.

Case 435. Under post partum hemorrhage. Case of twins, second baby. "A profuse flooding coming on the hand was introduced into the uterus, the membranes ruptured and the child turned and delivered by the feet in the usual manner." Mother and babies lived.

In 1927 there were 49 versions in 2,420 births an incidence of 2 per cent.

There were sixteen breech cases. The expression "breech extraction" is not used and only one breech delivery was described. It would be classified now as a breech extraction. Presumably others were extracted. The fetal mortality was 9 (56 per cent). In 1927 there were 87 breech cases. Seventy-three extractions with a gross mortality of 18 (20.6 per cent).

MANUAL REMOVAL OF THE PLACENTA

The placenta was removed manually eighteen times either on account of retention or hemorrhage. There was only one death; this was due to sepsis (vide Case 358, under maternal mortality). This surely is a most remarkable record considering the ignorance of infection and lack of anesthesia. In 1927 the placenta was removed manually five times with no mortality.

No mention was made of induction of labor or of episiotomy.

COMPLICATIONS

Hemorrhage. There were 9 cases of bleeding, 3 ante partum and 6 post partum. The only death (vide Case 358 under maternal mortality) occurred from sepsis after removal of the placenta fourteen hours post partum for "flooding." This, too, is striking in the absence of asepsis and without the use of packing, bags, pituitrin, hypodermoclysis infusion, transfusion and cesarean section. In 1927 there were 5 cases of placenta praevia, 12 of premature separation of the placenta and 22 of post partum hemorrhage of varying degree. There was no death in these groups.

Case 253. "At the commencement of the pains considerable hemorrhage occurred which ceased on the spontaneous rupture of the membranes and the labor went on naturally. The placenta remained attached to the uterus for some time and was not taken away from the vagina for five hours owing to the very great soreness of the external organs. On the third day this woman was attacked with Puerperal Fever. She was bled, blistered, purged, took an emetic and had several enemas administered. She was much relieved by the remedies mentioned, but at the expiration of twenty-four hours the pain returned accompanied by a profuse uterine hemorrhage which proceeded to an alarming extent and was finally arrested by iced water. The violence of the disease appeared to be checked by this critical evacuation and the patient soon happily recovered." Discharged after thirty-five days, mother and baby well.

Case 256. "This patient menstruated regularly every month during her pregnancy, hemorrhage occurred in the early part of labour which was arrested by rupturing the membranes. On the 10th day after delivery the hemorrhage returned, various remedies were used but not succeeding. The Spt's of Turpentine was used which completely succeeded." Discharged after twenty-five days, mother and baby well.

Case 396. "Placenta over the os uteri. The woman was attacked with violent pain accompanied by profuse hemorrhage." Discharged after eleven days, mother and baby well.

Case 126. "After delivery she had profuse hemorrhage followed by fever—unable to nurse the child for the want of milk. Child transferred to the Alms House." Mother discharged as cured after twenty-five days.

Case 134. (Vide multiple pregnancy.) Placentae removed for flooding. Mother and one child discharged well.

Case 358. (Vide maternal mortality.) Placenta removed fourteen hours post partum for flooding. Mother died.

Case 259. "On the eleventh day after delivery a profuse hemorrhage came on which was checked by cold applications. Nourishing diet and the internal use of Sulphuric Acid removed the debility and restored the health of the patient."

Case 264. "Three quarters of an hour after the delivery of the child a profuse hemorrhage came on owing to a partial separation of the placenta. From the necessity of the case the hand was immediately passed into the uterus which excited its contractions and forced the placenta into the vagina; which with a large quantity of coagulated blood was expelled by the next pain and the hemorrhage immediately ceased." Discharged after seventeen days.

Case 292. "Immediately after the birth of the child very violent flooding took place, so much so as to require the immediate delivery of the placenta. The hand was passed into the uterus which caused it to contract and force down the placenta into the vagina where it was left for half an hour and then removed. No hemorrhage succeeding." Discharged twelve days after delivery.

Case 435. "In this case the presentation & birth of the first child was natural. After tying & cutting the cord, on laying the hand on the abdomen it was evident there was another child, and on examination the two hands were found presenting through a second set of membranes. A profuse flooding coming on, the hand was introduced into the uterus, the membranes ruptured and the child turned and delivered by the feet in the usual manner. The hemorrhage still continuing, the hand was again introduced and the two placentas (which with their membranes were entirely distinct) taken away—one after the other. Then the uterus contracted & the flooding ceased. The woman having become very faint from loss of blood was roused by a little stimulus; & with the aid of an anodyne passed a comfortable night." Discharged cured, length of stay in hospital not stated.

ECLAMPSIA

There were three cases of convulsions, one post partum and two ante partum. The two latter died. The cases are beautifully described. It is interesting to note that no mention of urinalysis is made. The treatment was modern in as much as opium was freely used. In 1927 in 2,425 cases there were four cases of eclampsia on the private service but none on the public service, with no deaths.

Case 273. "This patient was attacked with hysteria and convulsions on the fifth day after delivery which was relieved by bleeding, blistering and opium. The cord was around the child's neck. It is necessary to observe that this woman did not get any sound sleep for 72 hours after delivery in consequence of being disturbed by the patients in labour."

This is a good observation of the necessity of labor rooms. This patient was discharged on the twenty-first day post partum.

Cases 350 and 354. (For both cases vide maternal mortality. They are well worth reading.)

There was no mention of cardiac cases, deformed pelves or of tumors. In 1927 there were 28 cases of cardiac disease, 132 deformed pelves of varying degree, 19 fibroids and 2 ovarian cysts.

MULTIPLE PREGNANCY

There were 9 sets of twins with no maternal mortality. Two babies were lost. There were notes on two of the cases.

Case 99. "Difficult labour. The anterior fontanelle was the presentation of the male. The female presented naturally."

This was evidently an observation of poor flexion.

Case 134. "Presentation knee & head. The child's head locked for several hours in the upper straight. In consequence of which the circulation in the cord was interrupted. Profuse hemorrhage after delivery of the child—both the placentae extracted—one from the cervix—the other from the fundus." Mother and one baby well. Discharged on twenty-fifth day.

The note on this case was very meagre. As the first baby, a still-birth, was a breech

presentation and the second a vertex, this was probably an example of partial locking of heads.

PROLONGED LABOR

There were 14 cases of labor lasting forty-eight hours or more, one case in 33. There was no maternal death and but one still-birth. No operative work was done, meconium and fetal heart were not mentioned. These cases worry us now but we have a better knowledge of the causative factors. We group them under posterior position, cervical dystocia, deformed pelvis, etc., and treat them accordingly. However, we have no satisfactory way of artificially completing dilation and effacement of the cervix. The recent development of the use of rectal analgesia in labor is one of our most important aids in the management of these cases. It relieves pain, gives rest and conserves strength while moulding, dilation and rotation are occurring.

There were six cases in which the labor was of forty-eight hours duration, one of fifty-two, one of fifty-three, one of sixty, two of seventy-two, one of seventy-five and two of ninety-six. The still-birth happened in one of the latter.

There were a few notes.

Case 66. "The labour continued 75 hr."

Case 85. "Labour continued 53 hr."

Case 111. "Labour continued 72½ hr.—hard time for Charley—could not go out on the 4th."

Case 133. "Labour continued above 48 hr."

Case 330. Aged twenty-six. "This woman was of a very weak and feeble constitution and pregnant with her first child. Labour pains came on about the full period & were at first strong. The waters broke in a few hours & the head presenting naturally could be felt. Her pains continued altho not so strong & it was not until the expiration of 72 hours that delivery was accomplished. The child was well altho the head was much distorted. Her strength was supported by light vegetable diet & an anodyne was given here." Discharged on forty-sixth day.

The average age was twenty-four years. All except 4 cases had prolonged stays in the hospital varying from sixteen to forty-eight days. The parity was stated in only 8 cases, 4 were primiparae and 4 multiparae.

During 1927 in 2,425 cases there were 30 instances of labor lasting forty-eight hours or longer, one in eighty. There was no maternal death. The morbidity, 100.4 for twenty-four hours, was 5 cases (16 per cent). The average stay in the hospital was thirteen days. Three cases had prolonged stays, sixteen, eighteen and twenty-three days respectively. There were 27 primiparae and 3 multiparae. The average age was twenty-nine. These cases, occurring once in eighty times and selected from 2,425 cases as being truly hard, long labors, no doubt are a more difficult group than the old series of 14 occurring in 469 cases. Six of the 30 had spontaneous deliveries. Three had cesarean section, one classical, one peritoneal exclusion, and one Latzko. Twenty were delivered by forceps, and one by version. The fetal mortality was 8, 4 still-births and 4 deaths summarized as follows:

1. Para I, aged twenty-four, fifty-five hours labor, spontaneous birth. Baby died after twenty hours.

2. Para I, aged twenty-one, forty-eight hours labor. Arm prolapsed following bagging. Version and extraction. Still-birth.

3. Para IV, aged forty, fifty-five hours labor. Three living children. Rigid cervix following amputation. Baby died during labor.

4. Para I, aged thirty-five, sixty-five hours labor; contraction ring concealed prolapse of cord. Baby dead, mother exhausted, cervix not fully dilated, high forceps. Wassermann 4 plus.

5. Para I, aged twenty-seven, seventy-one hours labor; meconium and failing fetal heart. Forceps delivery with rim of cervix present. Baby died after two days.

6. Para I, aged twenty-nine, seventy-three hours labor; meconium and slowing fetal heart. Forceps delivery with rim of cervix present. Baby died on second day.

7. Para I, aged twenty-seven, forty-nine hours labor; forceps for maternal exhaustion.

No cervix present. Baby died after ten hours. Intracranial hemorrhage.

8. Para 1, aged thirty, sixty hours labor; funnel pelvis, fully dilated five hours; rapid fetal heart; still-birth.

In 5 cases there was the difficulty of signs of fetal danger when the cervix was not completely dilated and effaced. These cases occurred in the group who were allowed to labor a long time in expectation that they would be delivered vaginally, as most of them were. No disproportion had been discovered. When signs of fetal or maternal danger appeared, delivery was required even though the cervix was not quite ready. Further labor was hopeless. Earlier interference might have been better but labor was allowed to continue in hopes the cervix would finally be effaced naturally. The more frequent use of incision of the cervix may have to be considered in this situation.

RETAINED PLACENTA

There were 22 cases of retained placenta. It was removed manually in 16 cases after a varying length of time and in the remaining 5 it was expelled spontaneously. There was one maternal death following manual removal. In 1927 there were 4 cases of retained placenta, and it was removed manually three times with no deaths. In this complication the results in the old series were excellent. It is a troublesome question now and much may be learned from studying these cases.

1. Case 27. "The placenta came away twenty hours after the child was born." Discharged on fifteenth day.

2. Case 124. "The placenta after being retained three hours was removed." Discharged after seventeen days.

3. Case 131. "The placenta was taken away after being retained one hour & a half." Discharged on twelfth day.

4. Case 134. "Both placentae extracted—one from the cervix—the other from the fundus for profuse hemorrhage after delivery of twins." Discharged on twenty-fifth day.

5. Case 163. "The placenta was taken away 14 hours after the delivery of the child." Discharged after forty-four days.

6. Case 190. "Placenta taken away by hand 2¼ hours after delivery." Discharged on twenty-seventh day.

7. Case 191. "The placenta was taken away by introducing the hand into the uterus 2¼ hours after delivery." Discharged after thirty-five days.

8. Case 193. "At the end of 2 hours the hand was introduced to take away the placenta but the uterus had the hour glass contraction which had to be overcome." Discharged after seventeen days.

9. Case 195. "Placenta taken from the uterus 2 hours after delivery." Discharged on fifteenth day.

10. Case 198. "Placenta taken from the uterus 2 hours after delivery." Discharged on eleventh day.

11. Case 209. "Placenta extracted 2¼ hours after delivery." Discharged on thirtieth day.

12. Case 222. "The placenta was extracted 3 hours after delivery of the child." Discharged on twelfth day.

13. Case 253. "The placenta remained attached to the uterus for some time & was not taken away from the vagina for five hours owing to the very great soreness of the external organs—Puerperal fever attacked her on the 3rd day." Discharged on the thirty-third day.

14. Case 264. "Three quarters of an hour after the delivery of the child a profuse hemorrhage came on owing to a partial separation of the placenta. From the necessity of the case the hand was immediately passed into the uterus which excited its contractions and forced the placenta into the vagina, which with a large quantity of coagulated blood was expelled by the next pain and the hemorrhage immediately ceased." Discharged after seventeen days.

15. Case 266. "The placenta not coming away it was deemed expedient to pass the hand into the uterus which was found to have the hour glass contraction. By gentle efforts the resistance was soon overcome and the placenta expelled. On the third day this patient was attacked with severe chill followed by fever and violent pain in the region of the uterus. The antiphlogistic treatment was actively pursued and in a few days she began to recover and continued gradually getting better until the 18th day after delivery when she was seized with uterine hemorrhage. After a short

time it was arrested but returned at the same time on six successive days, but in diminished quantities owing to her remaining in the horizontal posture and diligently using tonic and astringent remedies. Her recovery remained doubtful as her legs and abdomen began to swell. She was put on the use of the muriated Tincture of Iron which not only proved tonic but diuretic and she was in a short time discharged cured."

16. Case 285. May 20, 1818 (Dr. J. M. Campbell). "From the cord being around the neck and the child's head confined so long a time (33 hr. labor) in the pelvis it was apparently dead, but by inflating the lungs and using frictions it was soon restored to life. The mother was much exhausted by the labour. The external parts contracted very shortly after delivery and to a considerable degree; the uterus remained on one side of the abdomen and without any disposition to contract. From the circumstances it was thought most advisable to leave the placenta which came away in twenty-seven hours after the birth of the child." Discharged on the nineteenth day.

17. Case 319. "This woman was taken with labour pains attended with a slight flooding previously to coming into the house. Her pains were lingering for about 24 hours when they became more severe. The child was delivered without any difficulty but the mother lost a good deal of blood—no after pains following delivery & there was a slight discharge of blood and the placenta remained in the uterus. Cold was applied to the pubis but produced no abatement of the discharge and no pains. The discharge which was very small continued for 12 hours, but did not apparently affect the woman's constitution. As the uterus showed no disposition to contract, even when the hand was introduced into it, it was thought improper to remove the placenta. It was resolved now to try ergot. 1 drachm was infused in ½ pint water & one tablespoonful given. This in about 10 minutes was repeated & in 5 minutes more the placenta was expelled & the hemorrhage arrested." Discharged after fifty-four days; no notes on post partum course.

18. Case 328. "Placenta remained 5 hours." Discharged on fourty-first day.

19. Case 334. "The placenta was retained 14 hr." Discharged on twelfth day.

20. Case 358. "Placenta removed after 14 hr. for flooding. Mother died of puerperal fever after 6 days."

21. Case 429. "Placenta in this case was taken away after being retained 11 hours." Discharged on twenty-seventh day.

PUERPERAL FEVER

In the 469 cases delivered there were 14 cases of fever (possibly 16) with 6 (probably 8) deaths. The cases were scattered throughout the series. There were only two instances in which the interval between two deaths was short. Probably not all the cases mentioned as fever were truly septic. There were not as many cases as one would have expected for no doubt they were exposed to infection all the time in the hospital. There were surgical and medical wards in contact with the lying-in ward. However, many cases of temperature may have escaped unnoticed as there were no thermometers in those days. The notes on several cases are interesting.

Case 293. "The labor was natural & the child & placenta delivered without difficulty. On 2nd day after was bled & on 3rd was seized with puerperal fever preceded by a violent chill. Was relieved by purgatives and sudorifics. On the fifth day had another chill—was relieved by purging & a large blister. Had another slight chill, since which has continued well." Discharged after twenty days.

Case 294. "Mary Ritter after a happy delivery & all circumstances favorable was seized with puerperal fever for which she was bled & purged freely. These gave relief. A few days after was seized with another fever—relieved by a large blister and purging freely." Discharged on twenty-second day.

Case 450. "In this case the waters had come away on the evening of the 8th. The physician who was called in had attempted turning but in vain. She was therefore sent to the hospital on the 9th about noon. The hand at that time projected from the external orifice. Turning was then determined on—preparatory to which she was ordered an injection and a large anodyne was administered. On returning the hand previous to turning there appeared symptoms of a spontaneous evolution & she was left to nature. About 4 o'clock P.M. the child was born. The breech coming down till the feet could escape & then becoming a footling case. The child had been dead apparently about a fortnight.

The mother had rather a tedious getting up having some degree of fever with violent deep seated pain for about a week in the left hip joint. But from this she was relieved by blisters and the antiphlogistic treatment. During the whole of the time taken up in the evolution there was not the least retraction of the protruding arm." Discharged cured. The length of stay in the hospital was not stated.

Cases 506 and 507. "Died of puerperal fever accompanied with violent typhoid symptoms which resisted every medication that could be suggested."

These are the only consecutive cases in the series.

ABSCESS OF BREAST

There were three cases (4 cases in recent series). The method of treatment was not stated. There is an instructive note on *Inverted Nipples.*

"The child was unable to suck from the nipples being wanting. They appeared to be inverted. By the women sucking the breast one breast was brought into a state that the child could suck. Cups were applied to form a nipple in the other, but in vain."

SYPHILIS

This disease was noted in two cases.

Case 218. "This patient was received into No. 5 on the 3rd of Oct., 1816, and put on the use of the muriate of gold for syphilis. When delivered the disease was not yet cured and in consequence the child died two days after birth. After delivery the gold was resumed and she was discharged cured."

LACERATION

No mention of laceration is made and the word perineum was not used. In only one case was there any suggestion of repair.

Case 99. "Returned to the house as a surgical patient in consequence of an extensive injury to the vagina occasioned by an ignorant midwife." The patient had been discharged undelivered by request.

In only one case (431) was the baby's weight given. The child's weight was noted as 14½ lbs. It lived.

VACCINATION

It is interesting to note that vaccination was made a routine measure in 1810.

REMARKS

This old record gives evidence of the great progress which has been made in obstetrics and makes us appreciate our equipment. Most of the aids now considered essential were unknown then. Pelvimetry, prenatal care, social service, hospitalization, laboratory facilities, trained nursing, aseptic technique, modern methods of diagnosis including roentgenography, analgesia and anesthesia, the modern delivery room, varied operative procedures adapted to the individual case in interest of both mother and baby, improved emergency measures, immediate repair of lacerations, better knowledge of pathology, improved methods of observation and treatment, and finally the aid of the internist and pediatrician are all important factors and advances in modern obstetrical practice. These advantages have made childbirth comparatively painless and, in this series of cases, ten times as safe for the mother and at least three and one half times safer for the child at term. We realize that obstetrics has become a speciality with difficult medical and surgical phases.

BOOK REVIEWS

The first book we select from the stack at our elbow is a work the average physician would pass by, thinking it contained little to interest him. Unfortunately any volume with the word "Lectures" as part of the title is handicapped at the start. But the honest publisher must cleave close to the line and state facts and not resort to petty tricks to entice the unwary. Perhaps this is the broad cleavage line between scientific books and works of fiction. But within the covers of this volume before us is sufficient meat and facts and interesting matter to appeal to any taste.

The New York Academy of Medicine Lectures[1] is a book we recommend without

[1] Lectures on Medicine and Surgery, New York Academy of Medicine, First Series, 1927. N. Y., Paul B. Hoeber, Inc., 1928.

reservations to any doctor of medicine. It is a good sized book, beautifully printed and illustrated, 319 pages in length. There are 39 illustrations. On the title page we read that the lectures are on Medicine and Surgery (First Series, 1927). These lectures were given at the Academy on Friday afternoons.

We can do no better than to copy the contents:

The Treatment of Cardiovascular Syphilis, by Harlow Brooks; Intestinal Obstruction, by John F. Erdmann; Surgical Aspects of Medical Conditions, by John E. Jennings; Clinical Aspects of Common Otological Infections, by Samuel J. Kopetsky; General Infections by Bacteria, by Emanuel Libman; The Cutaneous Manifestations of Syphilis, by George M. MacKee; Climate in Tuberculosis, by James Alexander Miller; Useful Drugs in Clinical Practice, by Lewis K. Neff; Obstetrical Problems in General Practice, by John Osborn Polak; Surgical Aspects of Diseases of the Thyroid, by Eugene H. Pool; The Treatment of Pneumonia, by David Reisman; Pathological Causes of Human Misconduct, by Max G. Schlapp; Remarks on Eye Conditions, by John M. Wheeler; Problems of the Child's First Year, by Herbert B. Wilcox; Contagious Diseases, by Shirley W. Wynne. There is a complete index.

The various volumes of International Clinics[1] are widely known and deservedly so. The present volume (First volume, thirty-eighth Series) is 307 pages in length and has 3 colored plates and about 90 illustrations, charts, etc. There are nine articles under the heading Diagnosis and Treatment, three under Medicine, two under Pediatrics, five under Surgery, three under Traumatic Surgery, two under Otolaryngology, one article on Ophthalmology, two under Pathology, the 1927 Mütter Lecture of the College of Physicians of Philadelphia and an article on The Renaissance. The volume ends with an article on Progress of Medicine during 1927.

[1] International Clinics. Thirty-Eighth Series, 1928, Vol. 1. Edited by H. W. Cattell, Phila., J. B. Lippincott Co., 1928.

BOOKS RECEIVED

The Brain from Ape to Man: A Contribution to the Study of Human Evolution. By Frederick Tilney, M.D., PH.D. Two volumes, large 8vo, Cloth. Pp. 1160, 557 Illus. N.Y., Paul B. Hoeber, Inc., 1928.

The Principles and Practice of Obstetrics. By Joseph R. DeLee. 8vo, Cloth. Pp. 1140, 1128 Illus. Phia., W. B. Saunders, 1928.

The Mind of the Growing Child. Edited by Vis countess Erleigh. 12mo, Cloth. Pp. 241. N. Y., Oxford Univ. Press, 1928.

Gonococcal Urethritis in the Male. By P. S. Pelouze. 8vo. Cloth. Pp. 357. Illus. Phila., W. B. Saunders Co., 1928.

René Théophile Hyacinthe Laënnec. By Gerald B. Webb. 12mo. Cloth. Pp. 167. 14 Illus. N. Y., Paul B. Hoeber, Inc., 1928.

Die Chirurgie der Muskeln, Sehnen und Fascien. Von W. Muller. Lieferung 21, Die Chirurgie. 8vo. Paper. Berlin, Urban & Schwarzenberg, 1928.

Die Technik des Orthopädischen Eingriffs: Eine Operationslehre aus dem Gesamtgebiet der Orthopädie. Von Dr. Philipp J. Erlacher. 8vo. Paper. Pp. 492. 331 Abbild. Wien, J. Springer, 1928.

The International Medican Annual: A Year Book of Treatment and Practitioner's Index. 8vo. Cloth. Pp. 590. 86 Illus. N. Y., Wm. Wood & Co., 1928.

Diagnostik Mit Freiem Auge: Ektoscopie. Von Dr. Eduard Weisz. Dritte, erweiterte Auflage. 8vo. Paper. Pp. 196. 56 Abbild. Berlin, Urban & Schwarzenberg, 1928.

L'Anesthésié Epidurale. Par Germain Laporte. Preface de Victor Pauchet. 8vo. Paper. Pp. 54. Avec 17 figures dans le texte. Paris, G. Doin et Cie, 1928.

Folklore of the Teeth. By Leo Kanner, M.D. 8vo. Cloth. Pp. 330. 17 Illus. N. Y., Macmillan, 1928.

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